



# THE ANTI-TANK RIFLE

STEVEN J. ZALOGA





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# INTRODUCTION

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Anti-tank rifles were the largest and most powerful rifles of their day. They were also some of the most unwieldy and detested infantry weapons of World War II, often proving ineffective in their primary mission of defending the infantry against contemporary tanks.

The German Army was the first to develop anti-tank rifles in World War I to deepen its anti-tank defences. The most potent anti-tank weapon of 1917–18 was the field gun, forward-deployed in the direct-fire mode as an improvised anti-tank weapon; but although they were lethal against the thinly armoured tanks of World War I, they were never available in sufficient numbers. Furthermore, they were difficult to move around the shell-torn terrain. While anti-tank rifles could not offer the lethality of field guns, they could be used to plug gaps in the front line. The intention was to manufacture enough anti-tank rifles to give every infantry platoon a limited measure of anti-tank defence, but production of the Mauser T-Gewehr (tank rifle) began so late in the war that this objective was never met.

There was little development of anti-tank rifles during the 1920s, and scattered efforts did not resume until the early 1930s. Most of the tanks in service in the early 1930s were very thinly armoured, much like the tanks of World War I, with a typical armour level of 13–15mm armour plate. This level of protection was vulnerable to anti-tank rifles.

Armour penetration is largely dependent upon the amount of kinetic energy a bullet can impart against the target on impact. The kinetic energy of an anti-tank rifle's projectile is defined by the classic formula of  $E = \frac{1}{2}mc^2$ , where 'm' equals the mass of the projectile and 'c' equals the impact velocity. As can be seen from the formula, an increase of the projectile velocity has a greater effect in total impact energy than does an increase in bullet mass. As a result, anti-tank rifle designs most often focused on increasing the initial muzzle velocity of the projectile rather than increasing its weight.

**OPPOSITE** The substantial size of early anti-tank rifles is evident in this photo of a mud-encrusted T-Gewehr captured by the US Army's 77th Division in France during November 1918.





There are several ways to increase muzzle velocity, the most obvious of which is to increase the amount of propellant. Anti-tank rifle ammunition typically used an enlarged propellant casing with much more powder than a conventional infantry rifle. For example, the 7.92mm anti-tank rifles of 1939–40 typically had enlarged cases with about three times as much powder as comparable 7.92mm infantry rifles. There were numerous technical problems with excessively powerful propellant loads, however. Too powerful a charge could lead to premature barrel erosion. Very powerful charges could also lead to problems with cartridge extraction when the brass case became excessively deformed when fired.

Another method to improve muzzle velocity was to increase the length of the barrel. This allowed the propellant to act on the bullet for a longer period of time before it exited the muzzle. The Polish wz.35 (wzór: model) anti-tank rifle was the most extreme example of this, with a barrel length of L/151. This came at a cost, however, and the wz.35 barrel was rated at only 200–300 rounds before it became excessively worn. Most anti-tank rifles of World War II kept the barrel length under L/100 in order to extend the serviceable life of the barrel.

There was considerable interest in the early 1930s as to the possibility of using tapered-bore barrels (also called 'squeeze-bore' guns) to increase muzzle velocity. Many armies were intrigued by the 7mm Halger Ultra sporting rifle, developed by Hermann Gerlich, which had an initial muzzle velocity of an astonishing 1,100m/sec. The Ultra rifle used a smoothbore technique with a special barrel that started at one calibre at the breech, and then became narrower down the length of the barrel so that the bullet exited in a smaller calibre than at the start. This was accomplished by using a soft-metal jacket or flanges around the bullet that conformed to the restrictions during its travel down the barrel and exited at 6.6mm. The intention of this system was to maintain a higher pressure against the bullet while it travelled down the barrel than would occur with a more conventional barrel. This technology never proved effective in anti-tank rifle design, however, as the bullets became too deformed to be successful as armour penetrators. Larger-calibre tapered-bore anti-tank guns were developed during the war, mainly by Germany, but they remained very much on the fringe of anti-tank technology.

Most early anti-tank rifles used bullets with a hardened-steel core, this being necessary to ensure that the bullet survived the impact with the tank's hard armour plate. There were a few exceptions to this, such as the unique Polish DS bullet fired by the wz.35. The only major advance made in anti-tank rifle ammunition during World War II was the development of improved cores, typically involving some form of tungsten such as a steel/tungsten alloy or some form of tungsten carbide. The main attraction of this type of round was the greater density of tungsten, which permitted the ammunition designers to maintain the same ballistic shape as a steel-core bullet while increasing its density and hardness. For example, hardened steel has a density of 7.85g/cm<sup>3</sup> while tungsten carbide has a density of 13.4g/cm<sup>3</sup>. The main problem with the use of tungsten carbide was the scarcity of tungsten (wolfram) and its vital use for cutting tools in the machine industry. So, for example, Germany began using tungsten-



carbide cores in anti-tank projectiles in 1939–40, but drastically reduced their manufacture after 1941 as a consequence of the Allies pressuring neutral countries to stop exporting tungsten to Germany. Most German tungsten was reserved for use in machine tooling.

Small-calibre anti-tank rifles such as the Polish wz.35 and German Panzerbüchse 39 (PzB 39) were short-lived due to their marginal abilities to penetrate tank armour. Many armies had heavy machine guns in the 13–15mm range with secondary anti-armour capabilities, such as the US Army's .50-cal. Browning heavy machine gun. In some cases, lighter rifle versions were developed around their ammunition.

Some designers simply took the 'brute force' approach with their anti-tank rifles, opting for a very large calibre such as 20mm. Most of these weapons were inspired by the Swiss Solothurn and Oerlikon designs of the early 1930s, which were spin-offs from existing anti-aircraft cannon; but while these weapons were quite powerful, they tended to be heavy.

The heyday of anti-tank rifles was the late 1930s. The arms race in Europe saw a sudden increase in tank production in 1936–37, going from a few hundred tanks per year to several thousand. As a result, many armies began developing anti-tank rifles and anti-tank guns as an antidote.

While it was not recognized at the time, the combat experiences of the Spanish Civil War (1936–39) sounded the death knell of the anti-tank rifle. This conflict saw the combat debut of the first generation of dedicated anti-tank guns, namely the German Rheinmetall 3.7cm PaK 36 and the Soviet 45mm 19K. The light tanks of the day, such as the Italian L3 tankette, German PzKpff I and Soviet T-26, were thinly armoured and very vulnerable to penetration by these anti-tank guns. Indeed, many military observers concluded that anti-tank guns would sweep tanks off the battlefield just as machine guns had swept cavalry off the battlefield in World War I. While this was a hysterical over-reaction, it did cause most major armies to begin to improve the armour protection of their tanks. This is sometimes called the transition from 'bullet-proof' armour, adequate to defend against small-arms fire, to 'shell-proof' armour, adequate to protect against 37–45mm anti-tank guns and light field guns. To achieve this level of protection required an increase in armour from the 15–20mm range to the 40–50mm range.

The only factor that gave anti-tank rifles a brief reprieve was the time and cost involved in re-equipping tank forces with more heavily armoured

The German Halger Ultra sporting rifle used a tapered-bore design to increase the muzzle velocity of its projectile. It used a special bullet developed by Hermann Gerlich with soft-metal bands as shown in the inset here (not to common scale). This intriguing technology attracted the attention of several armies as a potential means to improve anti-tank rifle performance, but in the end, it was widely rejected. This particular Halger rifle was tested by the US Army at Aberdeen Proving Ground in 1932.



At the higher end, the category of anti-tank rifle begins to blur into the categories of light anti-tank guns and heavy machine guns. The 20mm Madsen gun is sometimes categorized as an anti-tank rifle, but as can be seen in this photo of a Finnish example in action in June 1942, it is closer in features to a heavy machine gun, lacking the characteristic shoulder stock of a rifle. One of the problems in preparing this book was to try to define a limit as to what constitutes an anti-tank 'rifle' versus an anti-tank 'gun'. This book limits the discussion to weapons of a calibre no greater than 20mm. Also, it only includes weapons with a shoulder stock; heavy machine guns with hand grips are excluded even though they are sometimes referred to as anti-tank rifles. In addition, this book focuses on rifles that actually entered service, primarily those of the belligerents. There were too many exotic prototypes to cover in a book as short as this. (SA-kuva)

shell-proof tanks. Some armies such as the French were beginning to mass-produce their new generation of tanks in 1936–37, and most of their tanks in 1940 had the thicker shell-proof armour. The Soviet Union also used shell-proof armour on its new generation of tanks such as the T-34 medium tank and KV heavy tank, though they still had a vast fleet of older, lighter tanks built in the mid-1930s that had thin armour. Germany was remarkably slow in adopting shell-proof armour, largely due to a tactical doctrine

that favoured speed and mobility over defensive protection.

As a result of the increasing armour appearing on tanks after 1937, the days of the anti-tank rifle were numbered. Germany's campaign against Poland in September 1939 was the only campaign in which the majority of German tank armour was thin enough to be vulnerable to anti-tank rifle fire. The Poles used their excellent wz.35 anti-tank rifle to good effect, but damaged or disabled far more German tanks than they destroyed outright. This campaign revealed a lesson already learned in World War I: anti-tank rifles could penetrate tank armour, but they had too little energy to do much damage once the armour was penetrated. Any hapless crewman in the path of an anti-tank rifle bullet was likely to be injured or killed, but the small-calibre bullets had no explosive fill and so could do little more than cause modest damage inside the tank itself. By the time of the Battle of France in May–June 1940, tank armour had already increased to the point where German anti-tank rifles were virtually worthless, and the heavier British Boys Anti-Tank Rifle proved little better.

Strangely enough, anti-tank rifles enjoyed a brief resurgence in 1941 when the Red Army belatedly began to adopt the powerful 14.5mm PTRD and PTRS. German tank frontal armour was largely impervious to the new anti-tank rifles, but the thinner 30mm side armour was still vulnerable to penetration. As a result, Soviet anti-tank rifles remained viable into 1942, but only if their users could get a side shot at close range. Very few German tanks were knocked out by Soviet anti-tank rifles, but many were damaged and their crewmen injured. It was not until the spring of 1943 that German industry managed to come up with a quick solution in the form of thin armour aprons (*Schürzen*) that finally made German tanks virtually invulnerable to anti-tank rifle fire. Anti-tank rifles remained viable in theatres where tank armour remained thin, such as in China. In spite of their obvious obsolescence, they never entirely disappeared from the battlefield since they could also be used against targets other than armoured vehicles.





# DEVELOPMENT

## A new weapon

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### THE GERMAN *TANKGEWEHR*

Armoured vehicles pre-dated the advent of the tank, mainly in the form of armoured cars. There was some interest in the development of anti-armour projectiles prior to World War I, primarily by hardening the bullet to permit penetration of light steel armour. The German Army, for example, had sponsored the development of the 7.92×57mm Patrone SmK (*Spitzgeschoss mit Kern*: pointed bullet with core), popularly called the 'K bullet', to deal with armoured sniper shields. This projectile used a tooled steel core to improve anti-armour penetration and could be fired by standard German infantry weapons including the standard Mauser Gew 98 rifle and MG 08 machine gun.

The first British tank attack on the Somme on 15 September 1916 caused alarm in the German Army when it became apparent that SmK bullets were bouncing off the British tank armour. A staff member of the Kriegsministerium (War Ministry) reported that 'Panzerautos gave the British an advantage. They have psychological impact because the trench defenses are helpless against them.' There was no real appreciation in the German Army for the effect of the SmK bullet until two tanks were captured after the Bullecourt attack on 11 April 1917. Even though many of the bullets simply bounced off a tank's armour, they often knocked off spall from the inside of the armour plate, injuring members of the crew. The British Army realized that the armour on the Mk I tank was inadequate when faced by the SmK bullet, and the improved Mk IV tank that saw its combat debut at Messines on 7 June 1917, had .5in (12.7mm) of hardened armour plate that further reduced the effectiveness of the German bullet.

The initial French Army tank attacks on 16 April 1917 provided incontrovertible evidence that the tank was no longer a mechanical curiosity, but rather would become a major factor on the battlefield. Even



The German 13mm T-Gewehr was the ancestor of all subsequent anti-tank rifles and the only type to see service in World War I. This is the earlier configuration with the heavier bipod.

Anti-tank rifles achieved their armour penetration power by using a large casing with substantially more propellant than conventional infantry rifles. This is a comparison of the German 13mm round for the T-Gewehr on the left and the normal Mauser 7.92mm rifle round on the right.



though the German Army considered artillery to be the primary defence against tanks, there was a growing recognition that some form of infantry weapon was needed to prevent 'tank panic' in the front-line trenches. To some extent, the new threat could be addressed by tactical changes such as widening trenches and forward-deploying more field guns, but the German Army was also forced to develop new anti-armour techniques.

On 12 October 1917, the German Army instructed the GPK (Gewehrprüfungskommission: Gun Testing Commission) to determine the best approach for infantry small-unit anti-tank defence. The development of a weapon capable of firing a 13mm anti-armour projectile was favoured, and the stunning British tank attack at Cambrai on 20 November 1917 made the project all the more urgent. On 27 November 1917, the GPK commissioned the Mauser plant in Oberndorf to develop an infantry anti-tank rifle, leaving it up to them to decide whether 13mm or 15mm was preferable. Mauser worked in conjunction with the Polte Patronenfabrik in Magdeburg on the development of the new ammunition, the requirement being to penetrate 25mm of armour from a distance of 250m. A new round using a 13mm projectile with a 13×92mm semi-rimmed cartridge was selected for the new weapon. Using a hefty 13g of propellant, the new projectile offered an energy more than four times greater than that of the normal 7.92mm Gew 98 rifle projectile – but this also meant that the recoil force experienced by the rifleman using the Mauser weapon was more than four times as great.

Once the ammunition was developed, design of the *Tankgewehr* (T-Gewehr) rifle proceeded quickly. Mauser decided on a simple, single-shot bolt-action design patterned on their Gew 98 rifle. The initial production version of the T-Gewehr had a barrel 860mm in length, but after the production of roughly 300 rifles, a lengthened barrel was used. The standard barrel selected was quite long, with a calibre of L/77. (Calibre is measured by dividing the barrel length by the bore, so 983mm/13mm = L/77.) The initial muzzle velocity of the 13mm projectile was 913m/sec. Owing to its heavy weight it was presumed that the T-Gewehr would be fired usually from a prone position. As a result, it was fitted with a bipod. The original bipod weighed 2.5kg; during the course of production, the lighter 1.3kg bipod of the standard MG 08/15 machine gun was substituted.



An interesting size comparison of the World War I Mauser rifles, with the Kar 98k carbine on top, the Gew 98 rifle in the centre and the T-Gewehr at the bottom. The T-Gewehr is the later type using the bipod from the MG 08/15 machine gun.

The first firing test of the T-Gewehr took place at Oberndorf on 10 January 1918 and a prototype of the rifle was presented to the Kriegsministerium (War Ministry) on 19 January 1918. Due to the urgency of the matter, an initial order for 30,000 rifles was placed immediately and the programme was given a top government priority classification, matched only by the U-boat programme. The first three rifles were delivered to AOK 3 (Armeeoberkommando 3: Third Army headquarters) on 18 March and production at Oberndorf reached 100 per day by the summer of 1918. Plans called for production to eventually reach 300 rifles per day to fulfil the 30,000-rifle contract by January 1919. As of 4 September 1918, 4,632 rifles were in service at the front. In total, about 14,700 were manufactured during the war according to Mauser records, though many of these had not been delivered when hostilities ceased in November 1918. Approximately 1,490 additional rifles were manufactured up to April 1919, bringing the final production total to about 16,910 rifles.

Combat experience with the T-Gewehr in the summer of 1918 led to requests to improve the performance of the weapon. The violent recoil of the rifle was very disruptive of rapid re-engagement of the target – a notable problem since a single round was unlikely to damage an enemy tank seriously. In response, Mauser developed a recoil system to reduce the level of recoil energy. In addition, the T-Gewehr was redesigned to use a five-round magazine to permit more rapid fire. A small number of these improved rifles were completed in the autumn of 1918, but none saw combat.

The 13mm Polte projectile also formed the basis for the TuF M18 (Tank und Flieger: Tank and Aircraft) heavy machine gun. This was based on the experimental Einheitsmaschinengewehr MG 16 and resembled a scaled-up MG 08 machine gun. Owing to its weight, it was deployed on the M1916 wheeled carriage. About 100 TuF M18 heavy machine guns (out of a planned 6,000) were completed at Maschinenfabrik Augsburg-Nürnberg by the war's end. Mauser was also commissioned to develop a heavy anti-tank rifle for service in 1919 in the 15–18mm range, capable of penetrating 35mm of armour at a range of 800m, but this design was never completed.

## THE POLISH wz.35

The Polish Army obtained small numbers of T-Gewehr rifles during the border fighting with Germany in 1920, but little serious work was undertaken on Polish anti-tank rifle design and development for nearly a decade. In October 1931, after purchasing and testing some Halger Ultra 'squeeze-bore' rifles, Polish technical officers were dismissive of the design, labelling it with the local expression 'dog's shoes'.

A team under Lieutenant-Colonel Tadeusz Felsztyn began work on a new projectile. The requirement was to penetrate 15mm of armour at 30 degrees at 400m, which was considered to be the most typical Soviet and German tank threat for the foreseeable future. With the adverse aspects of the T-Gewehr in mind, especially its excessive weight and debilitating recoil, the requirement demanded better performance in this regard as well. As a result, initial work focused on the use of a standard SC 7.92mm projectile as used in the Polish-manufactured Mauser 98 infantry rifle, but with much greater speed. The initial experiments examined various propellants and were conducted in conjunction with the State Ammunition Factory in Skarżysko Kamienna and the propellant factory in Pionki. There were predictable problems including premature barrel erosion (early tests demonstrated that barrel life was limited to only 20–30 rounds) and scaling. Felsztyn's team came up with the idea that it wasn't necessary actually to penetrate a tank's armour if the bullet's impact could cause the inner armour of the tank to spall, thereby creating a 'killing cork' that would bounce around the inside of the tank. Rather than use the usual hardened-steel core, Felsztyn's team tested a steel-jacketed lead core that could penetrate armour plate at short ranges but which could also deform against armour at longer ranges, transmitting most of its energy against the armour rather than ricocheting. Tests showed that the bullet usually knocked off a plug about 4cm in diameter from the inner face of the armour. The new DS round consisted of a redesigned 7.92mm bullet with a lead core and steel jacket and a substantially enlarged copper/zinc cartridge with 11.15g of smokeless powder. A more conventional steel-core projectile was also developed, the DSC, but this does not appear to have been manufactured in quantity.

While work was progressing on the new projectile, a variety of anti-tank rifle designs were tested. The first of these, by a Captain Kapkowski, was examined at the infantry centre in Toruń in February 1932, but failed to win Polish Army support. Two more designs followed. Antoni Karczewski, assistant director of the PFK (Panstwowa Fabryka Karabinów: State Rifle Factory) in Warsaw, completed a rifle weighing 16kg that used a recoil system. Competing against him was one of his former interns, a recent graduate of the Warsaw Polytechnic, Józef Maroszek. His rifle was considerably lighter, weighing 9.1kg, in part due to his decision to use a muzzle brake instead of a recoil system. Tests showed that the muzzle brake reduced the recoil by about 65 per cent. Comparative trials of the rifles were held at the range at Brześć-nad-Bugiem in October 1935, and Maroszek's design was declared the winner by the KSUS (Komitet do spraw Uzbrojenia i Sprzętu: Committee



on Weapons and Equipment). It was designated as the Karabin przeciwpancerny wzór 1935 (Anti-tank rifle model 1935).

The simple Mauser bolt-action, magazine-fed configuration of Maroszek's rifle was easier to manufacture and required no special training for the troops. This was of some concern since the weapon was considered top secret. The Polish Army was reasonably certain that contemporary German and Soviet tank armour could be penetrated by the rifle at normal ranges, but they were also aware that the rifle could be defeated if the likely enemies were to begin adding appliqué armour to their tanks. Both the rifle and its ammunition were kept secret until shortly before the outbreak of war in September 1939. They were sometimes codenamed *Urugwaj* (Uruguay) with the cover story that they were a rifle and ammunition intended for export to Uruguay. As a result, the rifle was commonly called the Kb.Ppanc. wz.35 'Ur'.

The Kb.Ppanc. wz.35's recoil was not significantly worse than that of the standard Mauser Kar 98k rifle due to its effective muzzle brake. The DS projectile was 7.92×107mm with a lead core and steel jacket and weighed 14.6g; the round weighed 64.2g and contained 11.2g of smokeless powder. The bullet had an initial muzzle velocity of 1,300m/sec. Tests found that it would punch through 15mm of armour at 30 degrees at 300m, or 33mm of vertical plate at 100m. Barrel durability of the wz.35 was 200–300 rounds before erosion substantially reduced performance; each rifle was issued with three spare barrels to deal with this issue.

After the 1939 campaign, the Wehrmacht collected remaining wz.35 rifles and put them into limited service, first designated as the 7.92mm Panzerbüchse 35(p) and later as the Panzerbüchse 770(p). In 1940, there were 880 of these rifles in German service and about 255,000 rounds of ammunition. To improve its performance, German depots remanufactured some Polish ammunition with German 7.92mm anti-tank rifle projectiles with tungsten-carbide cores. In January 1941, Germany sold 250 of these rifles to Italy, and later transferred most of the remainder to Italian units in Russia. Curiously enough, when Italy switched sides in September 1943, some of these rifles again turned up in the German inventory, this time designated as Panzerbüchse 770(i). The Red Army also captured some of these rifles, and tests later influenced Soviet anti-tank rifle design. Felsztyn was captured by the Red Army in 1939 and was given a rough time by Soviet intelligence trying to learn about Polish 'secret weapons'. A small number of these rifles also fell into Hungarian hands when Polish units retreated over the south-eastern border into Hungary in September 1939, and some of these were sold on to Finland in 1940.

The Polish 7.92mm Kb.Ppanc. wz.35 was the first anti-tank rifle to see extensive combat in World War II. It was a simple bolt-action rifle with an exceptionally long 1.2m barrel, which gave it a calibre of L/151. Polish Army infantry and cavalry troops were issued with a special carrying harness due to the weight and awkward 1.7m length of the rifle which was fitted with a simple bipod. The box magazine held five rounds and the rifle had a rate of fire up to ten rounds per minute. There was no dedicated ammunition pouch for the magazine and instead the riflemen were issued the standard pouches for the RKM wz.28 (Polish-manufactured Browning Automatic Rifle). Manufacture of the wz.35 began at the PFK in Warsaw based on a Polish Army order for 7,610 rifles; the first batch of 1,000 was delivered by May 1937, and 2,000 by October 1938. There is some dispute regarding the number of rifles produced before the outbreak of war, with current estimates being about 6,000: about 4,500 rifles were in the hands of troops and another 1,500 in mobilization depots or the PFK. This particular example was displayed at the Ordnance Museum at Aberdeen Proving Ground for many years.



## GERMAN ANTI-TANK RIFLES OF WORLD WAR II

Although 805 T-Gewehr rifles were still in secret Reichswehr stocks in 1925, the new Heer (Army) of the 1930s showed no interest in this old and discredited weapon, though it remained in use in some training units into the early years of World War II. As in Poland, the interest was in a more practical gun that offered less recoil and lighter weight.

The first step in this direction began in 1932 with the development of improved anti-armour ammunition for potential use with tank machine guns. The first significant German weapon in this period was developed under the direction of B. Brauer at GWWS (Gustloff Werke-Waffenwerk Suhl). This was an extremely complicated design using a recoil system to avoid the bone-crunching problems experienced with the old T-Gewehr. A more unusual feature was the use of a falling breech-block design, more commonly found on artillery pieces than on military small arms. When the rifle was fired, the barrel recoiled; the breech automatically opened, ejected the spent casing and remained open to permit the gunner to load another round. GWSS developed a new 7.92×94mm round for this weapon, codenamed the Patrone 318 since it used an 8mm bullet on a case derived from the old 13mm T-Gewehr. (During World War II, the Heer usually abbreviated 7.92mm as 8mm.) Another oddity of the design was that it was available with both an 8mm and 13mm barrel. The early production batch of 400 rifles employed a 36-round drum (*Patronentrommel*), for stowage rather than as a real magazine. In the event, the standard service version had two clip-on boxes that could be carried on either side of the rifle to facilitate reloading.

The original version of the Gustloff rifle was called the Panzerbüchse 38 (PzB 38) and entered production in the summer of 1939. It offered a respectable 25mm penetration at 300m, but it was evident almost from the outset that this rifle had serious problems. The first 116 weapons were fitted with an unsatisfactory bipod, so subsequent rifles were fitted with the type from the MG 34 general-purpose machine gun. The recoil system did cure the recoil curse of the T-Gewehr, but at the same time the new rifle was burdened by a formidable 16.2kg weight. On top of this, the weapon was complicated and expensive to manufacture. Production began in the latter half of 1939 and there were 62 of these rifles in service at the start of the September 1939 Poland campaign, along with 59,400 rounds of ammunition. A limited test series was manufactured at GWWS

The PzB 38 proved to be too complicated and too expensive for mass-production.



totalling 703 in 1939 and 705 in 1941, for a total of 1,408 when production ended in May 1940.

The initial version of the Patrone 318 round, designated formally as the SmKH (Spitzgeschoss mit Kern: pointed bullet with core; H = tungsten carbide), featured a tungsten-carbide core and had a muzzle velocity of 1,200m/sec. It was quickly replaced by the

Patrone 318 SmKH Rs L'spur, which had a lower velocity of 1,140m/sec. This was certainly one of the oddest anti-tank rifle bullets produced during the war. The 'Rs' in the designation was an abbreviation for *Reizstoff* (tear-gas) and the bullet had a small vial containing 16mg of Phenacyl chloride tear-gas in its base. The idea was that once the round penetrated the armour of an enemy tank, the tear-gas would be sufficient to force the crew to abandon their tank. Allied accounts indicate that the amount of tear-gas was insufficient to force the crew out of the tank, however. Furthermore, some Allied tests found that the vial tended to separate from the projectile on impact, thus remaining outside the tank. The 'L'spur' in the designation indicated *Leuchtspur* (tracer). Germany's supply of imported tungsten carbide declined precipitously in 1941 due to British pressure on certain neutral countries such as Portugal. As a result, its use in projectiles was sharply curtailed. A hardened-steel core version of the Patrone 318 was developed, but it is unclear how much of the production run used this configuration.

In an effort to redeem the PzB 38 design, GWWS developed the simplified Panzerbüchse 39 (PzB 39) in 1939. This got rid of the complicated recoil system and semi-automatic breech. Instead, the falling breech was opened using the pistol grip. To replace the recoil system, the design also introduced a muzzle brake, probably influenced by the Polish Kb.Ppnc. wz.35. Another practical innovation was the use of a folding stock to shorten the length of the rifle when being carried. The redesign reduced the overall weight from 16.2kg to 12.6kg, and it used the same ammunition and had the same ballistics as the PzB 38. Production of the PzB 39 started in March 1940 and 9,645 were completed by year's end. Production was extended to Havelwerk GmbH in Brandenburg and Waffenfabrik Steyr in Austria, with 29,587 rifles completed in 1941 for a total of 39,232; about half (17,410) came from Steyr. Production of the associated Patrone 318 ammunition totalled 9.4 million rounds up to 1942.

In early 1941, a more formal process of developing an infantry anti-tank rifle was started by the HWA (Heereswaffenamt: Army Ordnance Department). It is something of a mystery why in 1941 the HWA still pursued a new anti-tank rifle after the 1940 experience against French and British tanks. Although the requirements called for a rifle roughly the



One of the more unusual features of the PzB 39 was the provision for two small ammunition boxes that could be attached on either side of the rifle to speed the reloading process. (SA-kuva)

same size as the PzB 39 and based around the Patrone 318, the HWA wanted an eight-round magazine and either automatic or semi-automatic feed. This led to four competitive designs: the Walther Panzerbüchse 40, Mauser Panzerbüchse 41, Gustloff Panzerbüchse 42 and Krieghoff Panzerbüchse 43. These rifles were later redesignated as Panzerbüchse 40 with their names identified in a suffix, for example Panzerbüchse 40(K) for Krieghoff. Each of the firms built slightly over 100 prototypes for trials which were conducted in the summer of 1941. By the time the trials were under way, however, the Wehrmacht had invaded the Soviet Union, and word quickly spread about the thickly armoured T-34 and KV tanks. This effectively ended Heer interest in a new 8mm anti-tank rifle, since none of these stood a chance of penetrating the armour of the new Soviet tanks.

There were a number of attempts to develop a heavy anti-tank rifle. Berlin-Suhler Waffen- und Fahrzeugfabrik developed at least two 15mm designs, based around Luftwaffe ammunition. One of these was an elaborate design offering a drop-breech and recoil system similar to that on the PzB 38, while the other was a simple bolt-action, single-shot design. These did not progress very far after 1941 as the advent of the T-34 and KV tanks rendered them useless.

The only other German anti-tank rifle to see production was actually a Czech design that resulted from the work of Československá Zbrojovka A.S. Brno (Czechoslovak Brno Arsenal) on anti-tank rifles for the Czechoslovak Army. The work, undertaken prior to the German occupation of Czechoslovakia in March 1939, led to the Brno arsenal being awarded a Czechoslovak Army contract in 1937 to develop three anti-tank rifles in 7.92mm, 13mm and 15mm. The first of these completed was the smallest of the trio, the ZK 382 that used a 7.92×145mm round. It weighed 10.5kg and was fed by a five-round magazine. An order was placed for 10,000 rifles, but none was completed prior to the German occupation. The factory was absorbed into the German armaments industry as Waffenwerke Brünn I, with the development office of the Brno plant subordinated to the SS-Waffenakademie Brünn (SS-Weapons Academy Brno).

On 16 December 1939, the SS-Führungshauptamt (SS-Main Headquarters) placed an order with Waffenwerke Brünn I for 2,000 7.92mm anti-tank rifles reconfigured for the Patrone 318 as well as 117 of the 15mm anti-tank rifles. The first 1,000 7.92mm rifles were completed in January 1941 and their testing was deemed satisfactory. However, the Heer became agitated in June 1941 when the Waffen-SS tried to place a large order for anti-tank rifle ammunition even though the new Panzerbüchse M SS 41 anti-tank rifle had not been developed or approved through the usual HWA system. HWA got its revenge later when the SS tried to get one of the German plants to manufacture new barrels for the rifle using new techniques instead of the expensive alloy steel barrel then in use. Curiously enough, the rifle appears to have remained in production until March 1943, with about 3,000 completed.

The second Czech anti-tank rifle, the 13mm, did not proceed to manufacture since by this time, the Germans wanted a more powerful

15mm weapon. The Panzerbüchse 243(Br) was based on the Czech 15×104mm ZB vz.60 heavy-machine-gun round and the design of the rifle was similar to that of the smaller PzB M SS 41. The first examples of the PzB 243(Br) were completed in the autumn of 1941. In October 1941, the rifle was designated as PzB 42(Br) and Panzerbüchse 42. There is conflicting information on whether any large-scale

production took place, with various sources suggesting that small numbers were provided to Italy and Croatia. After the war, the Brno plant tried to export the rifle as the 15mm vz. 41.

Several other Czech anti-tank rifle projects were undertaken under German supervision. The prolific Czech inventor František Janeček developed experimental squeeze-bore anti-tank rifles before the war, similar to the Halger Ultra sporting rifle mentioned earlier. The HWA contracted the Waffenfabrik Böhmen und Mähren in Prague to develop further two of his designs: the Panzerbüchse L11, which used an 11mm bullet that was squeezed down to 7.9mm; and the L15, which used a 15mm bullet that was squeezed down to 11mm. Test-firings of both rifles began in November 1940, but Janeček died in June 1941 and the development programme was subsequently suspended.

The advent of the Soviet T-34 and KV tanks in the summer of 1941 rendered anti-tank rifles increasingly obsolete and accelerated German work on shaped-charge warheads. A number of anti-tank hand grenades were developed as well as rifle grenades. Rather than dispose of the large numbers of PzB 39 in service, a programme was started in 1942 to convert them into dedicated grenade launchers. The original barrel was shortened by 580mm and a *Schiessbecher* ('shooting cup') grenade attachment fixed to the barrel. The rifle could no longer fire the Patrone 318 anti-tank bullet, and instead used the TreibPatrone 318 blank cartridge with an inert wooden slug. The bipod was lengthened by 55mm for a better launch angle, and the stock was fixed and strengthened to absorb the recoil. A special sight was also added. The converted rifles were designated as Granatbüchse Modell 39 (GrB 39). The first 1,416 PzB 39 conversions were completed in 1942 and 26,607 in 1943 for a total of 28,023 GrB 39.

The German Army made some use of captured anti-tank rifles during the war, and these are mentioned in the relevant sections of this book.



The PzB M SS 41 was an off-shoot of a prewar Czechoslovak design that was taken over by the Waffen-SS. This particular rifle was captured by the US Army during the 1944–45 fighting, though by this stage of the war, German anti-tank rifles had largely been withdrawn from service or converted into rifle-grenade launchers.

## THE BOYS ANTI-TANK RIFLE

The British Army sponsored the development of an anti-tank rifle in World War I, namely a single-shot bolt-action rifle designed by Major Philip Godsall using a new .600/.500in cartridge. The absence of a sufficient German tank threat removed the need for any such weapon, however, and no serial production was undertaken. Serious work did not resume until 1934 when the Small Arms Committee initiated design of a new anti-tank rifle. The effort was led by Captain H.C. Boys, the Assistant Superintendent of Design at the Royal Small Arms Factory, Enfield. The rifle was based on a new .55-cal. (14mm) round with a steel-cored bullet which in turn was based on the US Army .50-cal. machine-gun round. Design was largely completed in 1936 and the rifle was officially accepted for service on 24 November 1937. During development, the rifle had been codenamed as the Stanchion, but the Small Arms Committee decided to rename it as the Boys Anti-Tank Rifle following the death of its principal designer in November 1937, a few days before the rifle was accepted for service. Production began at Enfield, and was later extended to BSA (Birmingham Small Arms).

The Boys rifle used a top-loading magazine, and so the sights were located on the left side along with a small wooden cheek pad for the gunner. Instead of a bipod, it used a T-shaped monopod. Recoil mitigation was accomplished by means of a muzzle brake and a recoiling barrel. In spite of these features, however, the rifle had a bad reputation for brutal recoil. As a result, a number of .22-cal. training devices were eventually developed, including an in-barrel .22-cal. device, and a method to attach a rifle alongside the Boys for sub-calibre training.

The original design specifications were not especially demanding, requiring 16mm of armour penetration at 100yd (91m). The original cartridge, the S.A. Armour Piercing .55in W Mk I, was approved in December 1936 and offered performance inferior to that of the old Mauser T-Gewehr; it was declared obsolete in December 1939. The shortcomings of this round led to the development of an improved type, the Cartridge S.A. Armour Piercing .55in W Mk II, which used a lighter bullet and a larger propellant charge. This was approved in June 1939 and offered better penetration than the T-Gewehr. Based on examination of captured German anti-armour projectiles, an armour-piercing composite rigid (APCR) bullet was designed in 1942 with a wolframite (tungsten/steel alloy) core in an aluminium jacket with an aluminium or Bakelite windshield. Although this projectile offered better anti-armour penetration, the degree of improvement was not sufficient to warrant production since a new anti-tank grenade launcher, the PIAT (Projector Infantry Anti-Tank), was expected to enter production later in 1942.

The British Army deployed the Boys Anti-Tank Rifle in densities greater than any other army. While most armies limited the deployment to platoon level, the British Army deployed it down to section level. For example, in a mechanized platoon equipped with Universal Carriers, there was one Boys per section, or four per platoon in 1939–40. As a result, a British infantry division in the early period of World War II had 361 Boys rifles. Under the revised 1941 tables, the division had 444 Boys rifles since





The Boys Anti-Tank Rifle Mk I used a monopod and round muzzle brake, as evident on this example supplied to the Finnish Army in 1940. (SA-kuva)

the platoon had been enlarged to four sections with four anti-tank rifles per platoon. In total, some 68,847 Boys rifles were manufactured in Britain until August 1943. Besides extensive distribution to Commonwealth forces, Britain also provided 3,200 Boys rifles and 1.76 million rounds of ammunition to the Soviet Union.

Production of the Boys Anti-Tank Rifle was later undertaken by John Inglis and Company in Toronto, Canada, funded by the US Lend-Lease programme. During the course of Canadian production, changes were introduced to the baseline Mk I. The Canadian Mk I\* introduced a flat 'harmonica' muzzle brake in place of the original round design, probably based on US experience with the Solothurn anti-tank rifle design. Also, the Mk I\* used a more conventional 'inverted V' bipod. Canadian production began in April 1942 and concluded in December 1943, totalling some 45,234 rifles and 4.2 million rounds of ammunition. It is something of a mystery why this production was undertaken, given the widespread acknowledgement of the inadequacies of the Boys rifle by this time. Aside from those supplied to Britain and the Commonwealth, 6,129 Canadian-built Boys Mk I\* rifles were sent to China, and more than 700 to the United States.

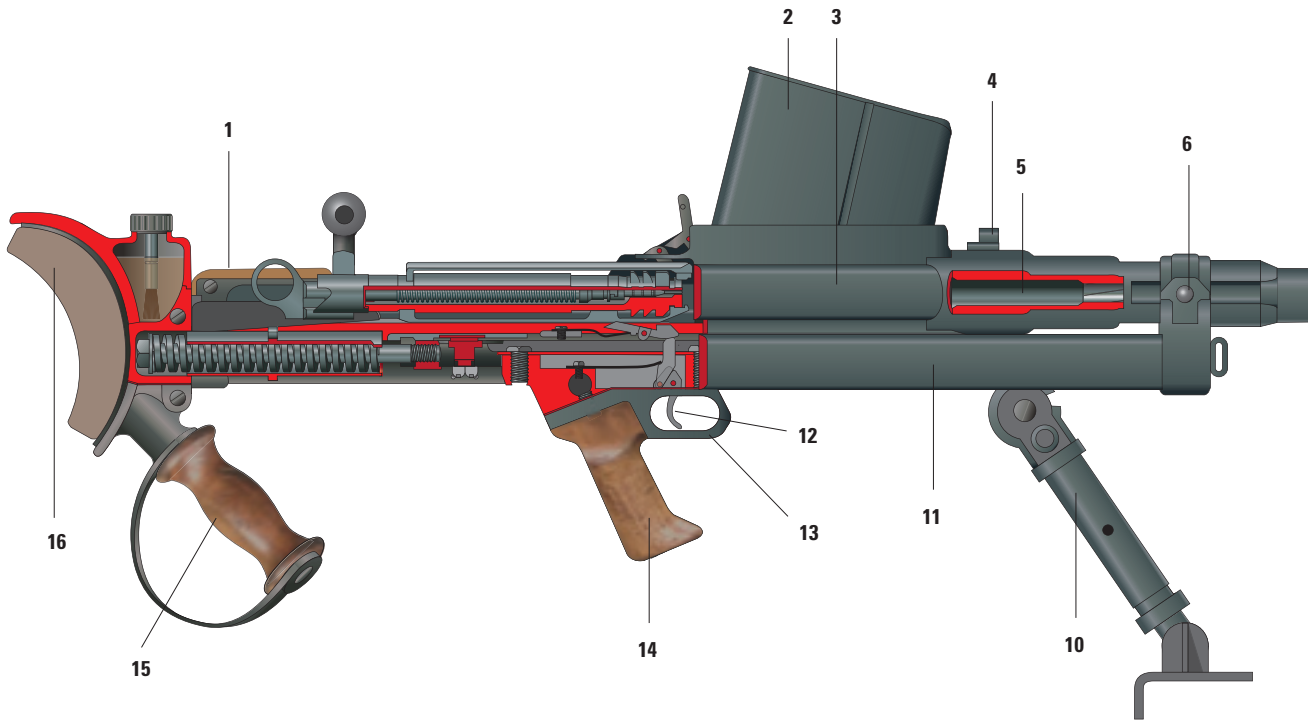
There was some interest in a lighter and shorter version of the Boys rifle for use by airborne forces, but by the time that work on the Mk II was under way in 1943, the weapon was clearly inadequate for tank fighting and the PIAT would soon be available. A number of other schemes to improve the rifle were initiated, but most were short-lived due to the recognition that they would not improve its performance sufficiently to justify the effort. For example, the Canadians considered the development of a dedicated rifle-grenade version inspired by the German GrB 39, but this scheme was stillborn.



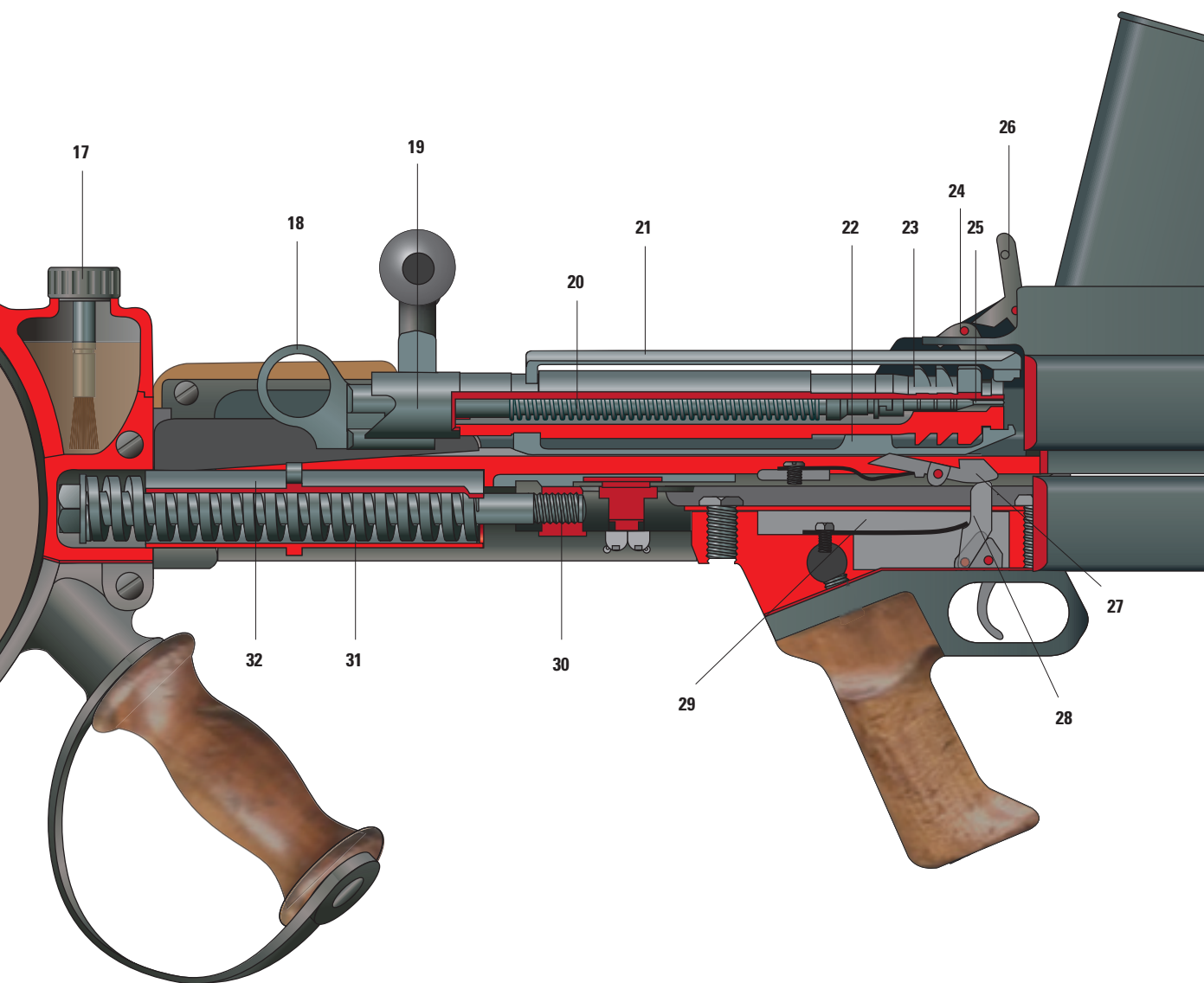
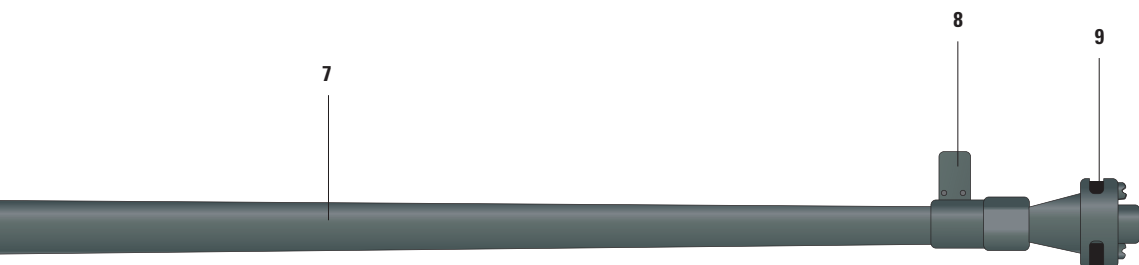
The Canadian-manufactured Boys Anti-Tank Rifle Mk I\* featured several notable changes from the baseline Mk I including a 'harmonica' muzzle brake and an inverted 'V' bipod.

# THE BOYS ANTI-TANK RIFLE EXPOSED

## .55in Boys Anti-Tank Rifle Mk I



1. Cheek piece
2. Magazine
3. Body
4. Rear sight
5. Chamber
6. Trunnion
7. Barrel
8. Front sight
9. Recoil reducer
10. Front support
11. Cradle
12. Trigger
13. Trigger guard
14. Pistol grip
15. Shoulder piece grip
16. Shoulder piece
17. Oil bottle
18. Cocking piece
19. Bolt
20. Main spring
21. Ejector
22. Extractor
23. Locking lugs
24. Ejector stop
25. Striker
26. Magazine catch
27. Sear
28. Trigger pawl
29. Trigger pawl spring
30. Buffer nut and screw
31. Buffer spring
32. Buffer cylinder



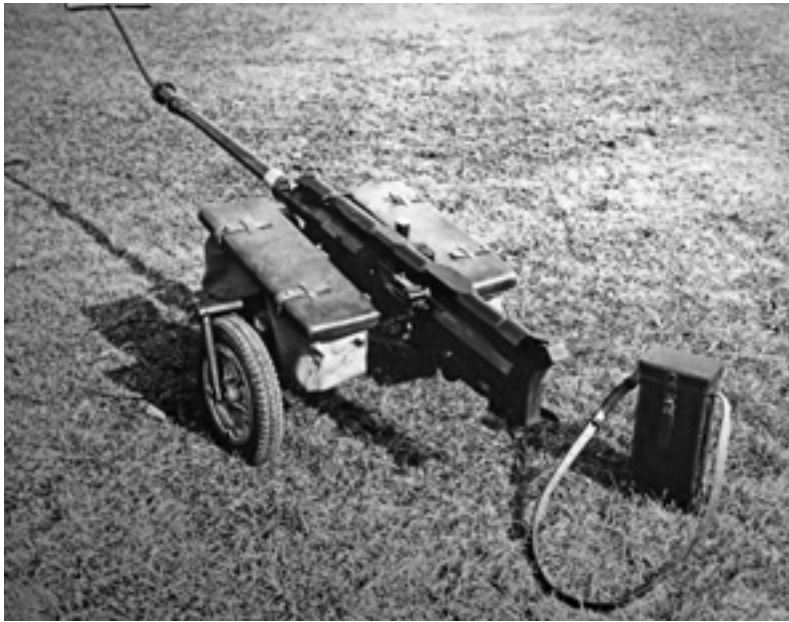
## SOLOTHURN ANTI-TANK RIFLES

The Treaty of Versailles, signed on 28 June 1919, placed considerable restrictions on German post-World War I weapon manufacturing. To circumvent these restrictions, in 1929 Rheinmetall set up a wholly owned subsidiary in Switzerland, Waffenfabrik Solothurn, to undertake gun manufacture. Engineers at the main facility in Germany developed many of Solothurn's weapons, but production was undertaken in Switzerland. Among the weapons developed for the firm were a number of 20mm automatic cannon such as the naval 2cm MG C/30 and the 2cm Tankbüchse 518 armoured vehicle gun. The first effort towards an anti-tank rifle was the 2cm Tankbüchse S 5-100, designed in 1932 by a Rheinmetall team including Fritz Herlach, Theodor Rakula and Louis Stange. This was based on an anti-aircraft gun and was short-lived. A more practical design emerged in 1933–34 as the S 18-100. This was a large and heavy weapon, weighing 44kg. To keep down overall size, it used a 'bullpup' configuration, with options for either a five- or ten-round magazine charged with 20×105mmB cartridges. The S 18-100 was first offered for export in 1934, and it was tested in Italy in competition with 20mm Breda and Oerlikon guns. Its performance was not particularly good considering the size and weight of the gun, with an initial muzzle velocity of only 735 m/sec and penetration of 20mm at 30 degrees at 100m. The Italians rejected the S 18-100 as having too little armour penetration for such a substantial weapon. The Netherlands purchased six of the improved S 18-150 in 1937 for trials, but deferred any large-scale purchase until a more powerful cartridge was available. The Swiss Army and the Wehrmacht also obtained small numbers of the gun for trials, but did not proceed to acquisition.

The S 18-100 also attracted the attention of the Hungarian Army, which was already acquiring Solothurn light machine guns. It was adopted as the 36M 20mm Nehézpuska and manufactured under licence by Danuvia Gépipari RT in Budapest, starting in 1936. Due to its size, weight and cost, distribution of the 36M in the Hungarian Army was modest. Deployment was usually on a scale of two rifles in an anti-tank platoon at company level, though it took several years before most of the Hungarian Army could be equipped to this level. The S 18-100 was also selected to arm Hungarian armoured vehicles including the 38M Toldi light tank and the Csaba armoured car. Production continued until 1943 in spite of the weapon's evident obsolescence.

The S 18-100 had mixed results on the international export market due to its mediocre armour penetration and heavy weight. It was licence-manufactured in Hungary in large numbers. It underwent modest redesign in the late 1930s and this is one of the S 18-154 rifles purchased by Finland in 1940. (SA-kuva)





Some of the later versions of the S 18-100 were offered with a simple transport trailer, but this lacked the tripod developed for the later and heavier S 18-1000. This particular example is one of those sold to the US Army in 1939.

Solothurn sold the S 18-100 to several other nations including Bulgaria in 1936. The Estonian Army purchased four S 18-100 in 1936 for testing. Instead of obtaining licence rights, however, they decided to reverse-engineer the rifle and manufacture it at the Arsenal plant in Tallinn, completing some test examples in 1938 and starting an initial production series of 20 rifles in 1940. These were deployed with the 1st and 7th Infantry regiments on the Estonian–Soviet Union border at the time of the Soviet occupation of Estonia in 1940.

Development of the S 18-100 continued with variants such as the S 18-150, S 18-154 and S 18-500, though none of these appears to have been exported in any large quantities due to the lingering shortcomings of the weak cartridge. Due to the size and weight of the weapon, Solothurn developed a small two-wheeled carriage to enable infantrymen to tow it by hand rather than have to carry it. In 1940, 12 S 18-154 were purchased by Finland despite German pressure against such sales, but they arrived too late to take part in the Winter War of 1939–40.

A complete redesign of the S 18-100 series was undertaken in the late 1930s, emerging as the S 18-1000 in 1940. This was based around the improved 'Long Solothurn' 20×138mmB cartridge, a lengthened barrel and other improvements. Owing to its substantial weight, the weapon was generally sold along with an associated SO 9 wheeled carriage which also served to carry two ammunition boxes. The S 18-1000 used three rounds: the basic *Panzergranate* anti-tank round, the *Stahlgranate* high explosive round and the *Übungsgranate* training round.

The Swiss Army placed an initial order for 60 S 18-1000 in 1939, where it was designated as the Tankbüchse Solo 40; eventually some 93 were acquired. The S 18-1000 was also widely exported. After having rejected the S 18-150, the Netherlands placed an order for 340 S 18-1000 for the Royal Netherlands Army and 322 for the KNIL (Koninklijk





The Solothurn S 18-1000 could be fired from its SO 9 wheeled carriage as shown here, though ideally it was supposed to be lowered to the ground on its fixed tripod for better stability. This is a US Army trial of the Solothurn at Aberdeen Proving Ground on 9 April 1940 prior to its intended adoption as the 20mm automatic gun T3 with telescopic sight T16 on gun carriage T3.

Nederlands-Indisch Leger: Royal Dutch East Indies Army) of which 125 Dutch Army and 72 KNIL rifles arrived prior to the German invasion of the Netherlands in May 1940.

Italy had rejected the S 18-100 in 1934, but selected the improved S 18-1000 in 1939 as the Fucile anticarro tipo S. Deliveries began in the summer of 1940 and late in the year, Germany turned over 63 war-booty Dutch rifles as well. There is some question regarding the total number of S 18-1000 ordered by Italy, but it is believed that the requirement was for 1,131 rifles, of which 578 were delivered by early 1942. German units made some use of the Solothurn rifles as the 2cm Panzerabwehrbüchse 785, using the suffix (s), (i) or (h) depending on whether the guns were purchased from Switzerland or obtained from Italian or Hungarian sources.

The final variant of the rifle was the S 18-1100 which permitted both semi-automatic and full-automatic fire. Some S 18-1100 were delivered as anti-tank rifles on the normal SO 9 wheeled carriage; for example, the Italians received some of these in June 1942. Total production of the Solothurn S 18 family at the Waffenfabrik Solothurn is not known, but an



S 18-1100 delivered to Italy from the 1941 production series had the serial number 2754, suggesting that production was probably in the 3,000 range.

By 1941, Solothurn realized that its days as a dedicated anti-tank weapon were numbered, but it could still be attractive as a dual-purpose anti-tank/anti-aircraft gun. For the latter role, the weapon needed a far more substantial carriage as well as appropriate sighting equipment. This emerged as the Dreibrinr derlafette SO 11 carriage, but this version is outside the realm of anti-tank rifles and in the autocannon category.

It is worth noting that the Swiss Army acquired another anti-tank rifle in 1941 from the Eidengenossische Waffenfabrik in Bern. Based on the existing 24mm Panzerkampfwagenkanone 38 tank gun that armed the Panzerwagen 39 light tank, the 24mm Tankb chse 1941 (Tb 41) was moved using a special two-wheeled carriage and could be fired either from the carriage itself, or the wheels could be removed and the carriage unfolded into a heavy tripod. In the towed configuration on the carriage the Tb 41 weighed 132kg. In spite of its designation, however, it was not really man-portable and better fits in the category of light anti-tank guns.

## US ANTI-TANK RIFLES

Edwin Pugsley, an engineer with the Winchester Repeating Arms Company, developed a .50-cal. magazine-fed anti-tank rifle in December 1918, but this attracted little US Army interest due to the war's end. The US Army tested the Mauser T-Gewehr after the war, but there was little interest in anti-tank rifles until the 1930s. The most important outcome of the T-Gewehr trials was the decision to develop the 13mm round as the basis for the new Browning .50-cal. heavy machine gun. In 1932, the US Army purchased the Halger Ultra rifle as the possible basis for an anti-tank rifle. After trials at Aberdeen Proving Ground, however, the US Army concluded that it was not practical for use as an anti-tank rifle.

In November 1933, the US Army adopted the .50-cal. M2 heavy barrel (HB) machine gun for use as an anti-tank gun as well as a weapon for mounting on infantry light tanks and cavalry combat cars. The cavalry expressed interest in a lighter 'anti-mechanization' weapon, and a pilot was constructed using the .50-cal. air-cooled aircraft gun with a buttplate and pistol grip, mounted on a bipod and fitted with a T3 telescopic sight. The weapon was redesigned using the 45in (114cm) heavy barrel and a new buttplate design. When provided to the infantry for trials at Fort Benning, they concluded that it was inferior to the existing tripod-mounted heavy machine gun. Although the existing tripod-mounted machine gun was 22lb (10kg) heavier, it could be broken down into three loads compared to two loads for the anti-mechanization weapon, the heaviest of which was an excessive 77lb (35kg). The real problem was that the infantry had recognized as early as 1934 that the .50-cal. round was declining in value in the anti-tank role due to the increasing armour of modern tanks. There had been attempts to improve the .50-cal. round by using double base powders and enlarged cases. These improvements raised the muzzle velocity to 3,300ft/sec (1,005m/sec), but armour penetration increased by only 3–4mm. As a result, the infantry had sponsored the development of a new 37mm anti-tank gun in 1937.

The US Army considered adopting a lightened version of the .50-cal. heavy machine gun as an 'anti-mechanization weapon' and this shows the 1937 configuration.

Curiously enough, David Williams of Winchester Repeating Arms, developed another .50-cal. anti-tank rifle around 1940. This does not seem to have attracted serious US Army attention as by this time, the intention was to move to a more powerful cartridge.







In spite of the infantry's switch to a 37mm gun, both the cavalry and the US Marine Corps continued to express interest in weapons lighter than a towed 37mm gun. In 1939, Ordnance purchased two Solothurn S 18-100 guns and 2,000 rounds of ammunition for trials at Aberdeen Proving Ground, as well as by the Infantry Board and the Cavalry Board. The Ordnance tests found that the ammunition was poorly designed and offered only 2,400ft/sec (732m/sec) velocity with penetration little better than a standard .50-cal. machine-gun round. By the time that the S 18-100 trials had concluded, however, Solothurn had the improved S 18-1000 ready and it was first demonstrated at Aberdeen Proving Ground in April 1940. The S 18-1000 tests were far more satisfactory, and the weapons were transferred to the Infantry Board and Cavalry Board for further evaluation. Both branches concluded that the S 18-1000 was superior to the .50-cal. heavy machine gun in the anti-mechanization role and so it was standardized as the 20mm automatic gun T3 with telescopic sight T16 on gun carriage T3. Authorization was granted to purchase 50 of the guns and 50,000 rounds of ammunition, to be followed by licence production in the United States. Negotiations with Solothurn suddenly turned difficult, however, probably due to pressure from the parent German Rheinmetall company.

Ordnance was already developing the new .90-cal. Colt T4 aircraft gun and some thought was given to developing it on a tripod mount or a small wheeled carriage. Comparative tests were conducted at Aberdeen Proving Ground on 14–20 March 1941 between the .90-cal. Colt automatic gun and the 20mm Solothurn T3 gun. Although the Colt gun offered better armour penetration, it was much too heavy for ground forces use (it went in the opposite direction to the cavalry requirement since it was larger and heavier than the .50-cal. machine gun it was supposed to supplement) and automatic fire was not required for the anti-mechanization role. Ordnance recommended that the gun's weight be reduced from 170lb (77kg) to about 100lb (45kg) and that a small

The .60-cal. T1E1 anti-tank rifle was mounted on the same tripod as the .50-cal. heavy machine gun. By the time development had concluded in late 1942, the 2.36in 'bazooka' rocket launcher was entering service, eliminating the need for this heavy and awkward weapon.



The US Army asked Colt to attempt to adapt their new .90-cal. (23mm) T4 aircraft gun as an anti-tank rifle. Trials alongside the Solothurn S 18-1000 found that the T4 was much too large and heavy for the cavalry and Marine Corps requirements.

wheeled carriage like the Solothurn's be developed instead of the tripod offered by Colt. Development was never formally cancelled but the project fell into limbo. The issue was further clouded by suggestions that the 20mm automatic gun developed by Mark Birgkit in Switzerland be adapted to the anti-tank role. This gun, later known as the Hispano Suiza HS 404, was eventually manufactured for use on US aircraft, but an anti-tank-rifle version was never seriously pursued.

Parallel to these developments, in 1939 Ordnance began development of a larger .60-cal. round capable of 3,500ft/sec (1,065m/sec) for the anti-armour role. This emerged as the 15.2×114mm T17 cartridge which served as the basis for the .60-cal. anti-tank rifle T1. This was a tripod-mounted weapon and after initial trials in 1941, it was improved as the .60-cal. T1E1 anti-tank rifle. The T1E1 entered trials at Aberdeen Proving Ground in October 1942 and after successful tests, it was delivered to the Infantry Board at Fort Benning. The Infantry Board found the gun to be insufficiently mature, however. More importantly, it was much too heavy – the rifle and 160 rounds of ammunition weighed 233lb (106kg) and required a five-man team to carry them – and had much poorer armour penetration than the new 2.36in 'bazooka' M1 rocket launcher which could be carried by one soldier. The Infantry Board rejected the .60-cal. T1E1 anti-tank rifle in February 1943.

Although the United States did not manufacture any anti-tank rifles during World War II, there was some small-scale use of the Boys Mk I\* by US Marine Raiders and US Army Rangers. In addition, the United States funded Canadian production of the Boys rifle through the Lend-Lease programme. Of the 45,324 Boys rifles manufactured in Canada, 44,553 were distributed through the Lend-Lease programme and the remaining 771 were apparently delivered to the United States. The US Army Rangers had a distribution of 20 Boys rifles per battalion, though

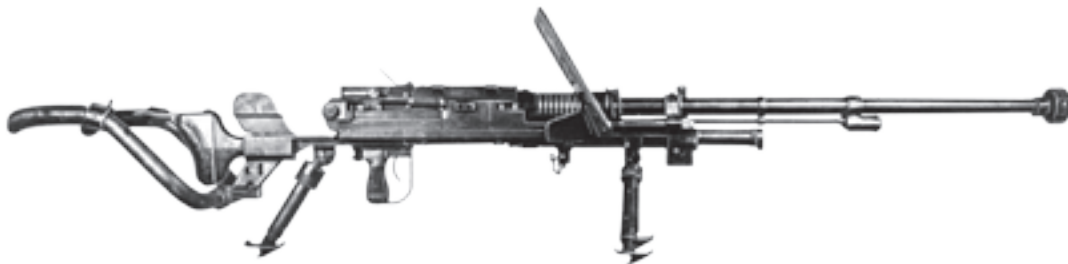
it is by no means clear that the weapons were ever deployed in combat due to the arrival of the bazooka rocket launcher in late 1942. The US Marine Corps had a standing requirement for an anti-tank rifle for special operations and became the principal operator of the Boys, using it in combat on a limited scale in the Southwest Pacific in 1942–43.

## THE JAPANESE TYPE 97 ANTI-TANK RIFLE

The Imperial Japanese Army faced a very modest tank threat during its campaigns in China, but began to receive reports of Chinese purchases of Vickers tanks. In 1935, the Army Engineering Division issued a requirement for an anti-tank rifle and a competitive programme was started. The Nagoya Arsenal offered a derivative of the 13mm Type 92 tank machine gun, while the Kokura Arsenal offered a 20mm design based around the 20×124mm cartridge used in aircraft automatic cannons. Testing was conducted in March 1936 (a Solothurn S 18-100 was obtained from Switzerland as a comparative example for the trials), and both types were sent back for improvements to fix problems discovered during the trials. A second round of tests was conducted at the Army infantry school in 1937, at which point the Nagoya 13mm rifle was rejected as not being powerful enough. The 20mm rifle was also sent back to Kokura for reinforcement of the bipod, and improvements to the trigger assembly and receiver. A total of eight prototypes were manufactured in 1937, followed by a limited production run of 50 rifles in 1938 for operational trials. The 20mm rifle underwent a third set of trials at the infantry and cavalry schools in December 1938, at which point it was accepted for service as the 20mm Type 97 anti-tank automatic cannon.

This was a dual-mode, gas-operated, magazine-fed design. It was one of the few anti-tank rifles of World War II that could be fired in both semi-automatic and automatic modes. The top-loading magazine held seven rounds. It was the heaviest anti-tank rifle of World War II, and exceeded its design specification of 40kg by a considerable margin. The complete weapon, including a protective armour shield, weighed 68kg. With its shield and carrying handles removed, it weighed 52kg and required a four-man crew to carry it for any distance. A wheeled carriage was developed for the weapon consisting of two wheels in front and a single small wheel attached to the gun butt, but this configuration was rarely if

A side view of the 20mm Type 97 anti-tank rifle, showing the weapon with the carrying arms on the rear station, but lacking those in front.





The 20mm Type 97 anti-tank rifle was especially heavy when fitted with its armoured shield as shown here, at nearly 68kg. This example has the front carrying arms, but not the rear set. These enabled the weapon to be carried by a four-man team, somewhat like a stretcher.



The 20mm Type 97 anti-tank rifle made its combat debut at the battle for Nomonhan (Khalkhin-Gol) in 1939. Here, a Red Army soldier inspects a captured example. This weapon still has the carrying handles fitted at the front and rear.

ever issued. The recoil was sufficiently violent that one of the crewmen was assigned to grip the forward bipod during firing to reduce the recoil effect on the gunner.

Serial production began at the Kokura Arsenal in 1939 with 1,008 manufactured until production ended in 1941. For unexplained reasons, production was restarted in 1943 at the Nihon Seikosho Company, with 100 more rifles manufactured when production finally ended in September 1943. Production was quite limited compared to the original requirement due to the growing ineffectiveness of the weapon, and its excessive weight.



It was also inordinately expensive, cost ¥6,400 at a time when a normal infantry rifle cost only ¥77.

The initial armour-piercing-tracer round, the Type 97, entered production in 1939 and used a solid steel projectile. There were three versions of the armour-piercing projectile, differing in the level of steel hardness. Besides the armour-piercing-tracer round, the 20mm Type 97 could also fire high-explosive-tracer, and high-explosive-incendiary-tracer rounds.

## THE FINNISH LAHTI L-39

The Finnish Army began to consider the development of an anti-tank rifle in the 1930s, but there was a lingering controversy over whether to use a new 13mm cartridge or to shift to a larger and more powerful 20mm cartridge. The Valtion Kivääritehdas (VKT: State Rifle Factory) was given a contract to develop a 13mm heavy machine gun for this role. The well-known Finnish small arms designer Aimo Lahti undertook the design. The first prototypes were completed in 1938 as the 13mm L-35/36 anti-tank machine gun. The infantry version was mounted on a tripod with detachable wheels. Three other prototypes were built: an armoured

The main problem with the big 20mm anti-tank rifles was their heavy weight and large size. This is a Finnish Army L-39 anti-tank rifle team near Aunus on 5 September 1941.





The 20mm L-39 anti-tank rifle is popularly called the Lahti outside Finland, based on its designer's surname. The combination bipod could be used with the legs lowered for stability, or folded up to use the adjacent skids to help drag the weapon in the snow. (SA-kuva)

vehicle gun mounted on a Landsverk L-182 armoured car, and two anti-aircraft machine guns. The infantry version weighed 35kg and armour penetration was mediocre, only 22mm at 300m and 18mm at 500m. Tests in the summer of 1939 showed that the weapon had inadequate armour penetration and so no serial production was undertaken.

The disappointing results prompted the Army to commission the development of a 20mm anti-tank rifle in 1939, once again designed by Aimo Lahti. This was based around Lahti's new 20×113mm cartridge. Once serial production started, however, the rifle was altered to use the existing 'Long Solothurn' 20×138mmB ammunition to simplify ammunition acquisition. The 20mm L-39 anti-tank rifle offered similar armour penetration to the 13mm design, but it did offer better post-penetration effects since it had a high-explosive fill. The rifle was semi-automatic and had a top-mounted five-round magazine. As a result of the success of the L-39, the 13mm project was cancelled on 11 August 1939. On 6 September, the Army proposed shifting the L-39 rifle into immediate production at VKT. When war broke out, only two prototype rifles were available and they were used successfully in the 1939–40 fighting. This rifle is widely called the Lahti anti-tank rifle outside Finland while it was nicknamed the *Norsuppyssy* (Elephant gun) by Finnish troops. The Finnish Army designation was 20 pst kiv/39. Serial production began after the end of the Winter War, with an initial order for 410 rifles from VKT. There were two further orders in 1941, bringing production to 1,852 manufactured up to 1944.

When the Continuation War began in June 1941, the 20mm rifle was becoming increasingly obsolete as an anti-tank weapon. The Red Army used lightly armoured tanks such as the T-26 and BT-7 on the Finnish front in diminishing numbers, and the 20mm rifle was ineffective against the more modern T-34 and KV tanks. As in other armies, the rifle remained in use since they were effective if clumsy for attacking other targets such as pillboxes. The problem posed by the Soviet use of the Il-2

Sturmovik armoured attack aircraft led to a 1944 effort to make the L-39 more suitable for anti-aircraft use. A special pedestal mount was developed and the L-39 was converted to full-automatic fire by the addition of a second recoil spring and changes to the firing mechanism. Experience showed that the rifle could not be used for prolonged automatic fire, but given the size of its magazines, this may have been a moot point. The automatic version was designated by VKT as the L-39/44 and by the Army as 20 it kiv/39-44 (ilmatorjunta-kivääri: anti-aircraft rifle). A total of 54 rifles from the third contract were modified into this configuration and a further 170 additional rifles ordered in July 1944, bringing the total to 224 L-39/44 and a total of 2,076 anti-tank rifles overall.

## SOVIET ANTI-TANK RIFLES

The Red Army was the last major army to adopt anti-tank rifles and the last to keep them in service. The first Soviet anti-tank rifle was the unorthodox 37mm Kurchevskiy recoilless rifle that could penetrate about 20mm of armour. It was put into production in 1933, but proved too dangerous for its own gunner and was withdrawn from service. There were a number of experimental rifles in the 20–25mm range that were tested by the Red Army in 1936. These weapons weighed 35kg or more, which the Red Army infantry leadership felt was too heavy. A second round of development took place at several of the small-arms design bureaus in 1936–38 aimed at developing a more practical weapon, and at least 15 designs in the 12.7mm–25mm range were considered, including one recoilless rifle.

One of the few positive outcomes of this work was the development of a new 14.5mm cartridge at the NIPSVO (Nauchno-issledovatel'skiy poligon strekovogo vooruzheniya: Small Arms Research-Testing Proving Ground) in Shchurovo. The first of these was the B-32 projectile, completed in 1939–40, which consisted of a hardened-steel core inside a soft lead sleeve within a steel jacket using a new and powerful 14.5×115mm cartridge. This was officially accepted for service use on 16 July 1941. The second projectile, the BS-41, used a similar configuration, but in place of the steel core used a denser and harder tungsten-carbide/cobalt (93+6) core. The BS-41 offered a roughly 10 per cent increase in performance over the steel-core B-32 projectile. Both types had a small incendiary filling for post-penetration effect. This cartridge was substantially more powerful than 7.92mm anti-tank rifles such as the Polish wz.35 or German PzB 39, offering 30.2–33.5kJ of muzzle energy (B-32/BS-41) compared to about 10kJ for the smaller-calibre anti-tank rifles. This was in large measure due to the substantial amount of propellant in the massive cartridge, some 30.9g.

A third round of development was initiated in November 1938 by the Main Artillery Directorate (GAU). Of the several rifles studied, the design by N.V. Rukavishnikov from NIPSVO was the most promising. The Rukavishnikov rifle was a semi-automatic design fed from a five-round magazine on the left side of the rifle. Competitive trials in late 1939 led to

a recommendation from the State Defence Committee to accept the weapon for service as the 14.5mm PTR-39 (Protivotankoviy ruzhë: Anti-Tank Gun) and to begin production of at least 50 rifles in 1939 and 15,000 rifles at the Kovrov small-arms plant in 1940. The intention was to provide 60 anti-tank rifles per rifle division.

The rifle never entered serial production for a variety of reasons. The production version of the new 14.5mm ammunition was more powerful than the developmental cartridges and led to extraction problems. There were significant mechanical problems with the design. While these could have been cured, the main problem was a faulty intelligence assessment which concluded that German tanks would be protected by 60–80mm armour. This assessment was seized upon by Marshal G.I. Kulik, head of the GAU, and led to the cancellation of several promising new anti-tank weapons including the new 57mm anti-tank gun on 26 August 1940.

At the time of the German invasion on 22 June 1941, each rifle division was nominally equipped with 60 anti-tank rifles and 54 45mm anti-tank guns. There is some mystery regarding the distribution of anti-tank rifles in the Red Army at the time. One artillery document indicates that 1,691 anti-tank rifles were lost from June to September 1941. As is detailed below in the Use chapter, there are other documents about anti-tank rifles being issued in August 1941. The origin of so many rifles is a mystery. It may have consisted of early batches of the Rukavishnikov rifle, captured Polish rifles and small production batches of test rifles.

Contrary to Kulik's assertions, it was quickly appreciated that German tanks were not as thickly armoured as feared. Lacking any adequate anti-tank weapons at small unit level, the Soviet infantry suffered from numerous instances of tank panic. The GAU considered reviving the Rukavishnikov rifle, but this was rejected eventually due to the complexity of the design. Rukavishnikov started design of a simplified rifle, but this never reached production due to the chaotic conditions in the small-arms industry at the time.

In mid-July 1941, GAU initiated a crash programme to manufacture a simple single-shot anti-tank rifle using the 12.7mm B-32 heavy-machine-gun round. In 1939, a team under V.N. Sholokov had developed such a rifle based on the old German T-Gewehr. This was very simple to

The 14.5mm Rukavishnikov PTR-39 was accepted for Red Army service, but never entered series production. It was a semi-automatic design with a side-loading magazine.







manufacture and small-scale production began in the workshops of the Baumann Institute in Moscow in late July 1941. The Sholokov rifle had completely inadequate performance and so no large-scale industrial production was undertaken. For obscure reasons, captured examples of the German PzB 39 were reverse-engineered at NIPSVO and put into production at the Tula small-arms plant based on a 10 August 1941 order for 5,000 rifles. In the event, only 426 of these were delivered to the Army due to the siege of the city by the Wehrmacht starting in October 1941.

In July 1941, the State Defence Committee under Stalin ordered the start of a crash programme to develop an anti-tank rifle based on the new and powerful 14.5mm cartridge. Two experienced small-arms designers, V.A. Degtyarëv and S.G. Simonov, were assigned to the project. Degtyarëv provided engineering drawings for a simple, single-shot, bolt-action rifle on 14 July 1941. The Simonov rifle took longer to develop since it was a semi-automatic design with a magazine, based in part on his 1938 7.62mm semi-automatic rifle. Test examples of both types were handed over to NIPSVO at the end of August 1941 for trials. Owing to the emergency situation, on 29 August 1941 both types were accepted for service as the PTRD (Degtyarëv) and PTRS (Simonov).

The simpler Degtyarëv PTRD went into production at the Kovrov small-arms plant (Kovrovskiy Zavod No. 2 imeni K.O. Kirkizhe) in October 1941 and the early batches were rushed into combat for the defence of Moscow. Production of the PTRD was extended to small-arms plant No. 74 in Izhevsk, and when production halted at Kovrov in November 1943, production was shifted to small-arms plant No. 385 in Zlatoust.

Manufacture of the PTRS was delayed due to the complexities of the design and the isolation of its development centre at the Tula small-arms plant No. 66. Due to the Wehrmacht siege of the city, the programme was transferred to the Saratov 'Traktordetal' plant No. 614 in October 1941, which further disrupted the start of production. To accelerate production, technical plans were also shipped to the No. 74 small-arms plant in Izhevsk. The first PTRS rifles were not completed until December 1941, however.

In 1939, a team under V.N. Sholokov developed a copy of the Mauser T-Gewehr, but chambered for standard Soviet 12.7mm heavy-machine-gun ammunition. Owing to the Soviet Union's desperate situation in the summer of 1941, one of the workshops at Moscow's famous technical university, the Baumann Institute, began manufacturing these by hand in July 1941. They can be distinguished from the German version by several details including the muzzle brake.



The 14.5mm Degtyarëv PTRD was among the simplest of World War II anti-tank rifles and also the most widely produced.

Work on other anti-tank rifles also took place in 1941–42, including M.N. Blyum’s design with enlarged 14.5mm cartridge and the 20mm RYEs rifle designed by the team of E.S. Rashkov, S.I. Yermolayev and V.E. Slukhodkiy. None of these proceeded beyond test batches. The only other anti-tank rifle to see extensive service with the Red Army was the British Boys Anti-Tank Rifle, with 3,200 shipped in 1941–44. A large portion of these were shipped as armament for the Universal Carrier, and the Boys tended to be used as vehicle armament rather than as an infantry anti-tank rifle.

As can be seen in the accompanying table, Soviet anti-tank rifles were the most widely manufactured type during the war, with nearly half a million being produced. Ammunition manufacture was also impressive, with some 139.8 million rounds produced in 1941–45.

The 14.5mm Simonov PTRS semi-automatic anti-tank rifle can easily be distinguished from its companion, the PTRD, by its box magazine which held a five-round clip.

**SOVIET ANTI-TANK RIFLE PRODUCTION**

|              | 1941          | 1942           | 1943-44        | Total          |
|--------------|---------------|----------------|----------------|----------------|
| PTRD         | 17,688        | 184,800        | 78,623         | 281,111        |
| PTRS         | 77            | 63,308         | 127,230        | 190,615        |
| <i>Total</i> | <i>17,765</i> | <i>248,108</i> | <i>205,853</i> | <i>471,726</i> |





# USE

## Anti-tank rifles in combat

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### THE T-GEWEHR IN WORLD WAR I

The 13mm T-Gewehr was first issued in March 1918, but did not see widespread service until the summer of 1918. It soon received the nickname *Elefantenbüsche* (Elephant Rifle). The T-Gewehr was operated by a two-man crew consisting of a gunner (*Schütze*) and assistant gunner (*Reserveschütze*), sometimes called an ammunition carrier (*Munitionsträger*). The gunner carried the weapon itself, a single cartridge pouch (*Patronenbeutel*) with 20 rounds, and a tool kit including accessories, a three-piece cleaning rod, a replacement firing pin and a can of gun oil. The assistant gunner carried an additional 112 cartridges weighing about 13kg and consisting of two 20-round cartridge pouches and a 72-round box (*Patronenkasten*). The T-Gewehr was so large and cumbersome that gunners were trained to fire from a prone position. The recoil from the rifle was so severe that German gunners joked that it was a three-shot weapon: one shot from the right shoulder, the second from the left shoulder and the third for a trip to the hospital. As a result, the gunner and assistant gunner usually alternated shooting. The assistant gunner was expected to act as an observer during an engagement and also to protect the gunner from enemy infantry.

The plan was to issue the T-Gewehr on a scale of three per infantry company. Owing to early shortages, however, the scale of issue was in reality significantly less. For example, when Infanterie-Regiment 137 went into action on July 1918 near Villers-Bretonneux, it had only two T-Gewehr and 85 rounds of ammunition.

The first recorded encounter with the T-Gewehr from the Allied side was a report by the French Army tank units AS 2 and AS 3 (AS: Artillerie Spéciale) during the fighting in the Bois Sénécat and at Grivesnes that they had been hit by a new type of rifle. They reported that the projectiles had

penetrated the outer appliqué armour of their Schneider tanks but that they had not managed to penetrate the main armour of the tank. A T-Gewehr from Infanterie-Regiment 137 was the first to be captured by British troops at Villers-Bretonneux on 4 July 1918. Encounters with the T-Gewehr increased through the summer, though the weapon was not greeted with any particular alarm by either British or French tank crews. The French assessed it to be no more than a nuisance, especially compared to other anti-tank weapons such as field guns and mines. A later American report stated that 'This weapon soon became a standing joke to the personnel of the British Tank Corps, who collected them with great glee as souvenirs.'

The reason for the weapon's lacklustre reputation was its marginal armour-piercing capabilities and its ineffectiveness even when a tank's armour was penetrated. Capitaine Chanoine, the commander of Groupement IV during the Soissons campaign, submitted a report on 1 October 1918 assessing the effects of the T-Gewehr. The rifle was largely ineffective against the Schneider tank as it usually hit the spaced appliqué armour, preventing it from penetrating the main armour. The smaller Renault FT light tank was more vulnerable. For example, one Renault FT was found with a hole completely through the mushroom dome of the cupola. Several Renault FT tanks suffered penetrations of their side armour, sometimes flying across the hull interior but otherwise being stopped by internal hull structure such as the ammunition racks.

Nor were the larger British tanks impervious to the T-Gewehr, especially when the rifles were used in a coordinated fashion. A clear example occurred during the fighting near Amiens in August 1918, involving a Mk V\* (O4 of 1 Section, A Company, 15th Battalion, Tanks Corps) commanded by 2nd Lieutenant Bell. During the fighting on 23 August near the village of Courcelles towards the Albert–Arras railway, Bell's tank was hit by anti-tank rifle fire. The first round hit the right sponson, injuring the gunner who 'immediately jumped out and nothing was seen of him afterwards', according to the memoirs of the section commander. Several more rounds struck the tank, injuring two more gunners. Another crewman replaced one of the 6-pdr gunners, spotted the German rifleman, and blasted him with a single round from the 6-pdr. In the meantime, a second German T-Gewehr gunner had opened fire on the tank, breaking open a steam-filled water line in the fighting compartment. Another shot hit the Hotchkiss gunner in the front of the tank. With the engine likely to overheat, the driver managed to put the tank into reverse and move back 150yd (137m) before the engine finally seized. By the end of the engagement, only three of the crewmen were uninjured. This was not an isolated incident; records of the 9th Battalion detail an incident on 26 August 1918 while operating in support of the Guards Division, in which one tank suffered five men wounded by anti-tank rifle fire.

The limitations of the T-Gewehr became apparent to the German Army early in its combat use. The Lehr-Infanterie-Regiment attached to Heeresgruppe *Deutscher Kronprinz* tested a rifle against a captured British tank and issued its report on 25 September 1918.

| LEHR-INFANTERIE-REGIMENT STATISTICS |                        |                                                                   |
|-------------------------------------|------------------------|-------------------------------------------------------------------|
| Projectiles                         | Range and impact angle | Effect                                                            |
| 4 rounds                            | 300m @ 60 degrees      | 3 penetrations, 1 deflection                                      |
| 4 rounds                            | 300m @ 45 degrees      | 3 deflections, 1 penetration                                      |
| 4 rounds                            | 200m @ 90 degrees      | 2 hits, 2 misses, serious engine damage                           |
| 3 rounds                            | 100m @ 90 degrees      | 3 penetrations, damage to gun and engine                          |
| 3 rounds                            | 100m @ 75 degrees      | 1 shot through mantlet opening damaging gun, 1 miss, 1 deflection |

The report concluded that none of the 18 rounds fired against the tank would have disabled it. The rifle was judged to be most effective when fired nearly perpendicular to the armour, and the more extreme the angle of impact the more bullet deflections became increasingly common. This assessment was circulated to senior commands on 1 October 1918 under General der Infanterie Erich Ludendorff's signature:

The opinion of the 13 mm anti-tank and anti-aircraft rifle (13mm Tank- und Fliegergewehr) formed by the troops varies considerably. Whilst the effect of the weapon against tanks is praised by some, others pass an adverse verdict upon it. These differences of opinion may be explained by the manner in which the rifle has been employed and the results which were expected of it.

It is evident that we cannot expect a tank to be put out of action at once and rendered incapable of moving by a single direct hit from a weapon of a caliber of 13mm; even if it penetrates the armor plating, several direct hits will generally be necessary, that is until the crew is put out of action or until the weapons and propulsion are rendered unserviceable. So it is necessary for the bullet to penetrate the armor plating, and still retain some momentum. In order to obtain this result, favorable angles of impact (60°–90°) and sufficient momentum, that is, fire at close ranges (220–330 yards [200–300m]), is necessary. The shorter the range and the more perpendicular the impact, the more certain is the effect. Bullets striking obliquely with angles of impact of

A T-Gewehr gunner on watch during the 1918 fighting. Behind him is an improvised shelter to protect against airburst and shrapnel. Experience with the T-Gewehr identified technical problems with the weapon. The recoil of the gun was extreme and the firing sequence was disrupted both by the recoil and the need to extract the spent casing and reload. All of this slowed the firing sequence while at the same time the gunner was well aware that he was facing a well-protected, mobile and dangerous opponent. The German Army hoped to mitigate these limitations by assigning the rifles to large, strong men and by stressing the effectiveness of the weapon when used under the right conditions.





less than 50° result in ricochets. The training of the troops in the new weapon must be conducted in such a manner that the rifleman is acquainted with the conditions necessary for its effective use. Only in this manner will he possess confidence in the weapon.

Anti-tank rifles had greater impact in the last months of the war due to their growing number. They were especially dangerous when used as part of a coordinated action involving several anti-tank rifle teams. The French units, especially the Renault FT light tank units, regularly mentioned the anti-tank rifle threat in reports from the Somme fighting in September–October 1918; but there was some dispute among French tank commanders regarding the threat. Chef d'escadron Hubert Lefevre, who led Groupement III in the Somme fighting, reported that the rifles were a continual threat and that his unit had lost several tanks to anti-tank rifle fire and had several crewmen killed and injured. In contrast, Capitaine Foranz, the commander of 504e Régiment d'Artillerie Spéciale, reported that the rifles were largely ineffective and that only a few of his unit's Renault FT tanks had been penetrated, with one tank commander killed in the incidents. The war diary of AS 310 for 25 October 1918 noted that three Renault FT tanks had been penetrated that day but no casualties were sustained. On the same day, however, AS 311 reported that Maréchal-des-logis Gillot had been killed when an anti-tank round penetrated the turret of his tank.

A German assessment of anti-tank defences in World War I written in 1937 concluded that 'Of the active defense weapons, the 13mm rifle proved to be ineffective. It was much too unwieldy and most of its projectiles failed to penetrate. It can therefore be assumed that the 13mm machine gun to be issued in the spring of 1919 would also have had little effect.' The British Army offered an even more jaundiced opinion of the anti-tank rifle's worth: 'The chief disadvantage of the anti-tank rifle, however, was that the German soldier would not use it, afraid of its kick and still more afraid of the tanks themselves. It is doubtful if one per cent of the AT rifles captured in our tank attacks had ever been fired.'

The T-Gewehr was not formally used by the Reichswehr after the war, though several hundred remained in secret stocks. Captured examples were widely examined by other armies.

### **German T-Gewehr strongpoint, summer 1918 (opposite)**

This shows an anti-tank rifle team of Infanterie-Regiment *König Wilhelm I* (6. Württembergisches) Nr. 124. The T-Gewehr was generally operated by a two-man crew. The gunner was responsible for the weapon while his assistant carried extra ammunition and usually acted as an observer. The T-Gewehr suffered from extremely severe recoil and was notorious for injuring the gunner, including collarbone fractures. As a result, it was customary to switch firing the gun from the primary gunner to the assistant gunner whenever practical. In the heat of battle, however, it was usually necessary to strike an enemy tank several times to cause any appreciable damage, so switching gunners in the middle of an engagement was not really feasible.







### **THE wz.35 IN THE SEPTEMBER 1939 CAMPAIGN**

The official allotment of wz.35 anti-tank rifles within the Polish Army was 2,760 to the 30 regular infantry divisions and a further 774 to the cavalry brigades. Additional rifles were distributed to various corps units as well as to the KOP border-guard units. Owing to secrecy, the rifles were delivered in crates with instructions that they not be opened until the receipt of special orders. This was at the discretion of local commanders and some units began issuing the rifles at the start of mobilization on 26–27 August 1939, while other units did not issue them until after the start of the war on 1 September. The rifles were supposed to be distributed in the infantry on a scale of three per company with one in each rifle platoon, with a total of 92 per infantry division. The cavalry issued them on a scale of one per squadron and 66–78 per cavalry regiment depending on regimental configuration.

Some units did not have much faith in the anti-tank rifle due to their unfamiliarity with the weapons. Units that had begun training on the rifle before the outbreak of war were more enthusiastic since they had



already seen that the rifles could easily penetrate armour plate at close range. The rifle became more popular after a few days of combat once units actually used them in combat. Results were usually best when it was used at ranges of about 100m which almost guaranteed penetration; but one of the main tactical problems with the weapon was the lack of any appreciable effect on the tank even when it was penetrated. Only in rare cases did the tank burn. This required a hit that ignited the fuel or ammunition. In some cases, tanks continued to move forward even after the crew had been killed or incapacitated; several of these 'ghost tanks' were mentioned in memoirs. Some units issued instructions to divisional engineers to use demolition charges to destroy any incapacitated German tanks and thus prevent the Germans from putting them back into service.

German armoured vehicle losses in the September 1939 campaign were high, totalling 674 tanks of which 217 were total write-offs; a further 309 armoured cars and light armoured vehicles were knocked out. Polish accounts attribute most of the total losses to the 37mm anti-tank gun and 75mm field guns. Many of the temporary losses were due to the

The German Army captured large numbers of wz.35 anti-tank rifles in 1939. After a brief career in the Wehrmacht in 1940, most would be sold on to Italy, Romania and other allies of the Third Reich. The Finnish Army bought small numbers from Hungary but they were quickly retired to the training role, as shown here at the Niinisalo training centre on 1 July 1942. (SA-kuva)









### Polish anti-tank rifle team, September 1939 (previous pages)

The Polish infantry anti-tank rifle generally operated in two-man teams. The gunner usually carried the anti-tank rifle ammunition in the same cartridge pouches as those used with the RKM wz.28, the Polish licence-manufactured Browning Automatic Rifle. The assistant gunner could carry additional ammunition, but his responsibility was to act as a second set of eyes for the gunner and to protect the gunner from hostile infantry. The wz.35 rifle was very effective in damaging lightly armoured German tanks such as the PzKpfw I, but it took a lucky hit on a fuel line or ammunition stowage to start a fire inside the enemy tank. More often than not, the anti-tank rifle projectile would simply injure or kill the crew.

anti-tank rifles, but this damage was repairable. Although German assessments of the wz.35 are not detailed, the immediate effect was a crash programme to improve the frontal armour on tanks prior to the France campaign of 1940. Since the PzKpfw I was already regarded as obsolete, priority went to the PzKpfw II which had only 13mm frontal armour. An additional 20mm armour plate was added which could defeat the Polish rifle at ranges of 100m or more. The PzKpfw III and PzKpfw IV medium tanks already had 30mm frontal armour, so there was less pressure to add more armour to these tanks.

The Polish wz.35 anti-tank rifle was awkward to carry due to its exceptionally long barrel. These photos show the prescribed carrying method for infantry and cavalry using the special harnesses developed in 1939. Notice also that a canvas cover was supplied to cover the bore and breech in order to minimize dust infiltration.





## GERMAN ANTI-TANK RIFLES IN COMBAT

During the September 1939 campaign in Poland, the German Army had only 62 PzB 38 anti-tank rifles in service. There is very little information on their use. Polish armoured vehicles at this stage were lightly armoured. The most numerous types, the TK and TKS tankettes, had a maximum of 10mm armour and the 7TP light tank had a maximum of 17mm, making them vulnerable at the normal combat range of 100–300m.

By April 1940, there were 1,118 8mm anti-tank rifles in service with the German Army. Approximately 660 PzB 35(p) were listed as being in service, but there is little information as to whether they were actually used in the summer 1940 campaigns. In addition, some examples of the more powerful 20mm Solothurn anti-tank rifle had been obtained and pressed into service. The usual deployment pattern was 90 anti-tank rifles per infantry division, with each rifle company having three such weapons.

In France in 1940, the German anti-tank rifles faced much more formidable armoured opponents. The most numerous French tanks were the Hotchkiss H 39 and Renault R 35, both of which had been developed as infantry tanks, specifically intended to be resistant to gunfire up to 37mm. They used cast armour which was up to 40mm thick on the frontal surfaces. As a result, they were highly resistant to the German anti-tank rifles except from the sides or at very close range. The larger French tanks, such as the cavalry's Somua S 35 and the armoured divisions' Char B1 bis, were even better armoured. There is very little statistical information on the causes of French tank losses in 1940, but German anti-tank rifles probably accounted for very few.

A PzB 38 in service in France in 1940. This is presumably a training scene as the muzzle brake has its canvas cover in place.





The PzB 38 made its combat debut in Poland in September 1939, arguably the only campaign in which it was combat effective against most enemy armoured vehicles.

By April 1941, the inventory of the new 8mm anti-tank rifles had increased to 25,298 in service; a few thousand more were added to the inventory prior to the launch of Germany's invasion of the Soviet Union on 22 June 1941. One of the main reasons that these weapons had not been withdrawn after the France campaign was because of the recognition that most Soviet tanks and armoured cars were lightly armoured. There were about 9,800 T-26 light tanks, 7,400 BT cavalry tanks and 3,600 other small tanks in Red Army service in 1941, with most having armour in the 15–20mm range. These proved to be extremely vulnerable to the new German anti-tank rifles, though as the Poles discovered in 1939, it took multiple hits to disable a tank or its crew. Approximately 21,000 Soviet tanks were lost in the 1941 campaign – the only campaign in which German anti-tank rifles were even marginally useful – so the old light tanks quickly disappeared from the battlefield. The Red Army was beginning to receive large numbers of T-34 medium tanks and KV heavy tanks, however, which were invulnerable to German anti-tank rifle fire. Later, captured Soviet 14.5mm PTRD and PTRS anti-tank rifles were used on an expedient basis.

The German anti-tank rifles remained in service through most of the 1942 campaign, in spite of their growing obsolescence. Some were also used by the Deutsches Afrikakorps, and there was a special





‘tropicalized’ version of the Patrone 318 anti-tank ammunition. On the Eastern Front in 1942, although the 8mm rifles had no value against the T-34 or KV tanks, one of the most numerous tanks in Red Army service in the first half of 1942 was the new T-60 light tank. The T-60 had 20mm frontal armour, but it was sloped steeply enough that penetration by German anti-tank rifles was not guaranteed. As mentioned earlier, German infantry began to receive shaped-charge anti-tank rifle grenades and other types of anti-tank devices which largely supplanted the anti-tank rifles for infantry-company defence by the summer of 1942.

As in many other armies, the anti-tank rifles remained in use by the German Army because they were powerful, long-range weapons that could also be used to shoot at other targets such as enemy infantry behind walls. The PzB 39 was retired late in 1942, and converted to a dedicated anti-tank grenade launcher. Some German anti-tank rifles remained in service until the very end of hostilities, with examples of the PzB M SS 41 captured in small numbers by the US Army in 1944–45, and by the Red Army as well. Nevertheless, the weapon left so little impression on the German Army that a recent German history of infantry combat against tanks in World War II, *Panzerknacker*, does not even mention anti-tank rifles.

## THE BOYS ANTI-TANK RIFLE IN COMBAT

Having made its combat debut in Finnish hands, the Boys rifle was used extensively by British forces in the 1940 campaigns in Norway, Belgium and France. At the time, each British Army rifle platoon had a single Boys rifle in the platoon headquarters; there were 361 rifles per infantry division. The Boys was widely used as an armoured vehicle weapon, especially in armoured cars and Universal Carriers. Besides its use by British troops, the Boys had also been provided to Belgium and France. The French Army was one of the few armies of the period which had avoided acquisition of an anti-tank rifle, judging that it would be obsolete before it entered service. Some Boys rifles were obtained in a barter deal, however, with Britain receiving 25mm anti-tank guns in exchange. The Boys rifles in French service were issued primarily to light reconnaissance units such as the GRCA (Groupe de reconnaissance de corps d'armée) and GRDI (Groupe de reconnaissance de division d'infanterie).

By 1940, the Boys rifle had become largely ineffective against German tanks with the exception of the old PzKpfw I. As mentioned

A large proportion of the Boys Anti-Tank Rifles were carried on vehicles, especially the Universal Carrier as depicted here. This is a unit from Canada's North Nova Scotia Highlanders during training in 1942, and their Universal Carrier has one of the Canadian-manufactured Mk I\* rifles fitted to the front embrasure. The unit markings have been censored on this wartime photo.



earlier, the PzKpfw II had received an armour upgrade after the September 1939 campaign due to the success of Polish anti-tank rifles, and this rendered it largely invulnerable to the Boys rifle from the front. German light tanks such as the PzKpfw II, PzKpfw 35(t) and PzKpfw 38(t) still had thinner 15mm side armour, however, which made them marginally vulnerable to the Boys rifle at close range so long as the impact was near perpendicular; impacts even at small angles could deflect.

The ineffectiveness of the Boys rifle soon became apparent. Tim Bishop, in his memoir of the 1940 campaign with the 12th Lancers on Morris armoured cars, recalled an encounter with German tanks: 'They were perhaps 400 yards [366m] away ... the second tank traversed its gun so I loosed off at it with the Boyes rifle and hit it on the side of the turret. For all the effect it had I might have been a little girl trying to hurt a heavyweight boxer' (Bishop 1993: 59). Bishop's unit was saved by a sudden downpour which prevented the German tanks from returning fire. ('Boyes' was a common misspelling of the rifle's actual name.)

The situation was not much better in North Africa. The Boys rifles were viable in the early fighting against Italian forces since they could penetrate the L3 tankette and the side armour of the M11/39 medium tank. However, these two types were soon out of service, replaced by the new M13/40 medium tank which had 25mm side armour that was impervious to the Boys rifle except at point-blank range. Typical Deutsches Afrikakorps tanks such as the PzKpfw III were also largely invulnerable. Indeed, in the wake of Operation *Crusader* in the autumn of 1941, the Eighth Army could not find a single instance of the Boys having been used successfully against an enemy tank. One account of the desert fighting recalled that the rifle was usually 'given to the company drunk to be carried as penance'. The inadequacies of the rifle were so widespread that the Canadian Army commissioned Walt Disney Studios to make a training cartoon in the hope of extracting some minor battlefield value from it.

As a result of its inadequate performance against contemporary tanks, the Boys was mainly used for engaging targets other than armoured vehicles, such as enemy infantry and unarmoured vehicles; and it still had some limited value as an anti-matériel rifle for any unit willing to haul its weight. For example, during the August 1942 Dieppe amphibious raid it was used with some success for long-range sniping against targets of opportunity.

The growing obsolescence of the Boys rifle led to a scramble to replace it. As in most armies at this time, the solution was the shaped-charge warhead. The British Army adopted the PIAT, which launched a shaped-charge grenade using a powerful spring. PIAT production began in August 1942 and as the weapon became available, so the Boys rifle was withdrawn from service. In July 1943, the remaining 100,000 Boys rifles in inventory in the UK were handed over to the Home Guard where they remained, unwanted and forgotten, for the rest of the war.

#### OVERLEAF

In spite of its increasing ineffectiveness against tanks, the Boys Anti-Tank Rifle remained in service until the advent of the PIAT late in 1942. This Canadian soldier of the Highland Light Infantry is armed with a Boys Mk I during a training exercise near Bognor Regis in England, 7 April 1942. (Library and Archives Canada PA-211306)









A Solothurn S 18-1000 on the standard SO 9 carriage in operation with an Italian Bersaglieri unit in North Africa in 1941.

## THE SOLOTHURN ANTI-TANK RIFLES IN COMBAT

The Royal Netherlands Army received 125 S 18-1000 anti-tank rifles prior to the German invasion of the Netherlands in May 1940. Most of these arrived too late to be issued to troops, however, and only a small number saw combat. In one of the more famous instances, a section of the 13th Border Battalion under Sergeant Van der Sande was defending Maastricht with two S 18-1000 rifles in sandbagged emplacements. The Germans had created a special Abwehr commando unit under Leutnant Hans-Joachim Hocke designated Bataillon zbV 100 (*zum besonderen Verwendung*: Special Purpose) to seize key bridges over the Maas River. This formation acted as the spearhead of 4. Panzer-Division in the Maastricht area, and provided some armoured cars to spearhead the assault.

Around 0515hrs on 10 May 1940, a German armoured reconnaissance patrol from Bataillon zbV 100 appeared and was brought under fire by Van der Sande's section. Two of the armoured cars were hit and stopped by S 18-1000 rifle fire. A third armoured car tried to pull one of the damaged vehicles away, but was also stopped by S 18-1000 rifle fire. The Germans eventually brought up a 37mm anti-tank gun and Van der Sande's section was eventually forced to retreat over the Maas. They had bought the Dutch defenders enough time that the Sint Servaes Bridge over the Maas could be demolished, however, thus

keeping the Germans on the other side in this key sector.

Some of the S 18-1000 anti-tank rifles arrived in the Dutch East Indies for the KNIL prior to the Japanese attack in December 1941. Little is known of their use in the campaign, however. Solothurn anti-tank rifles were widely used by various Axis armies including those of Italy, Hungary and Romania, but few details are known about their use.

The Solothurn S 18 anti-tank rifles were so heavy and awkward for infantry use that the Italian Army used many on vehicle mounts such as this Camionetta desertica SPA-Viberti Mod. 42, with the Solothurn on a centre pedestal mount with an 8mm Breda machine gun above and behind it, as shown here in North Africa in 1942.



## FINNISH ANTI-TANK RIFLES IN COMBAT

The Finnish Army had a motley selection of anti-tank rifles in use in the 1939–40 Winter War with the Soviet Union. The three prototypes of the 13mm L-35/36 anti-tank machine gun were deployed in the Taipale sector of the Karelian Isthmus, but their crews complained that ‘even from 30 meters range, the weapon couldn’t penetrate the armor of a T-26 tank, no matter where it was hit. Furthermore, the weapon was always out of order.’

Two prototypes of the new 20mm L-39 anti-tank rifle were deployed with the anti-tank platoon of JR 28, part of the Metsäpirtti detachment fighting near Lake Ladoga. The rifles proved very successful, and were credited with knocking out Soviet light tanks such as the T-26 at ranges up to 400m.

The Finnish Army’s lack of anti-tank rifles prompted efforts to try to import weapons, namely 100 T-Gewehr and 4,800 cartridges which Finland bought from Great Britain in the spring of 1940. After attempting to improve their performance by using other ammunition, they were put into storage and eventually scrapped in late 1944, never having been used. The British government delivered 100 Boys anti-tank rifles as part of a modest military aid package, with 30 of the rifles earmarked for the SFK (Svenska Frivilligkåren: Swedish Volunteer Corps). The Boys rifles proved to be effective against Soviet light tanks such as the T-26 and BT. Six of the rifles were lost in combat and another 16 lost or abandoned. A second batch of 100 Boys rifles arrived shortly before the end of the Winter War. These weapons were used again in the 1941–44 Continuation War, later reinforced by the purchase of more than 200 rifles from Germany that had been captured from the British Expeditionary Force in France in 1940.

Finland also attempted to buy Solothurn S 18-100 anti-tank rifles from Switzerland; but owing to its connections to Rheinmetall, Solothurn was pressured by Germany, then allied to the Soviet Union, to refrain from sales to Finland. Nevertheless, a dozen S 18-154 rifles were obtained under dubious circumstances via the Finnish embassy in Italy. These did not arrive in time for use in the Winter War, but they were used in the

The Boys Anti-Tank Rifle made its combat debut with the Finnish Army in the 1939–40 Winter War. This example is shown in use near Tokari-Latva on 3 June 1942. (SA-kuva)









## PREVIOUS PAGES

The big 20mm anti-tank rifles using the 'Long Solothurn' cartridges were among the most powerful weapons of this class. They were correspondingly difficult to employ, however, due to their size and weight. Here, a crew of young Finnish soldiers haul a 20mm Lahti L-39 anti-tank rifle up a forested hill near Hyrynsalmi on 20 June 1943. (SA-kuva)

The 20mm L-39/44 was adapted for anti-aircraft use and included a special pedestal for field use. The gun also could be fired in full-automatic mode.



Continuation War. A single S 18-1100 anti-tank rifle was obtained in 1942, by which time Germany was encouraging Switzerland to sell to Finland. The performance of the S 18-1100 was not that much better than the indigenous L-39 which used the same ammunition, however, and no further purchases were made.

Finland managed to buy 30 Polish wz.35 anti-tank rifles from Hungary which had obtained them when some Polish units had retreated over the border in September 1939 rather than surrender to the Germans, but the weapons did not arrive until after the Winter War had ended in March 1940. By the time of the start of the Continuation War in June 1941, their performance against Soviet tanks was poor and it was increasingly difficult to obtain ammunition. They were mainly used for training purposes.

The Red Army did not issue large numbers of PTRD or PTRS anti-tank rifles to troops on the Finnish Front until 1942. The Finnish Army captured its first PTRD rifles in 1942 and the first PTRS rifles in early 1943. Of the two types, about 250 PTRD rifles were used by the Finns during the Continuation War on an expedient basis, while only a few dozen of the PTRS were used.

The Lahti L-39 anti-tank rifle was widely used during the Continuation War. It was very effective in the summer 1941 campaign, since local Soviet units were still heavily equipped with older types of tanks with thin armour such as the T-26 and BT-7. As the war dragged on and tank casualties mounted, the Red Army units gradually began to receive better tanks including the T-34 and KV. As in the case of the German Army, the Finnish Army soon found that its anti-tank rifle arsenal had diminishing value in tank fighting. Nevertheless, the L-39 remained in widespread use in 1942–44 once the Finnish Army stopped large-scale offensive operations and resumed a defensive posture. The L-39 was especially prized for shooting at static Red Army positions such as bunkers and machine-gun

nests. However, its obsolescence became painfully clear when the Red Army staged large-scale offensives in the summer of 1944 to push Finland out of the war. By this stage, the Finnish Army was under no illusions about the combat potential of the L-39 rifle, and made urgent requests to Germany for the supply of *Panzerfaust* and *Panzerschreck* anti-tank rocket launchers.

## SOVIET ANTI-TANK RIFLES IN COMBAT

The combat debut of Soviet anti-tank rifles is shrouded in mystery as mentioned previously. Records of the 30th Army of the Western Front indicate that on 17 August 1941, the first anti-tank rifle companies arrived and were gradually deployed with the 162nd, 242nd and 251st Rifle divisions. The early use of the rifles (it is unclear what types were issued in the early summer of 1941) was ineffectual and 'reckless' and they were used mainly against German machine-gun nests.

The first examples of the Tula copies of the PzB 39 were so badly manufactured that they were withdrawn from Red Army service due to the danger they posed to their crews. A small number were used by the Tula Workers' Regiment during the defence of the city in October–December 1941.

The first PTRD rifles were delivered to the Western Front in October 1941 on the approaches to Moscow. About 300 PTRD rifles were issued to Lieutenant-General K.K. Rokossovskiy's 16th Army in October–November 1941. They saw their combat debut in the fighting near Shiryayevo on 15 November 1941, knocking out a single tank. The fighting continued near Petelino and Shiryayevo on 16 November 1941. Eight rifles had been issued to the 1075th Rifle Regiment, 8th Guards Rifle Division and they were credited with knocking out two German tanks at a range of 150–200m. The PTRD was well received since it provided a means of anti-tank defence at small-unit level. Most of the early rifle deliveries were to the Moscow area during the winter 1941–42 battles. The early rifles suffered from a number of manufacturing shortcomings, and there were frequent complaints about extraction of the casings. The complaints were serious enough that on 10 June 1942, GAU issued an order to the small-arms plants to fix various manufacturing and design flaws.

The main problem facing the Red Army's anti-tank rifles was the growing thickness of German tank armour. Encounters with the Soviet T-34 and KV tanks, as well as frequent clashes with the ubiquitous 45mm anti-tank gun, led to a steady process of German armour improvements. The standard German tank of the 1941 era, the PzKpfw III Ausf J, had 50mm frontal armour that was proof against the anti-tank rifles except at very close ranges. Side armour was still only 30mm, however, and this could be penetrated. As encounters between the Panzers and Soviet anti-tank rifles escalated in early 1942, the German Army decided to boost frontal armour on the PzKpfw III Ausf L by the addition of a 20mm spaced appliqué to the gun mantlet and superstructure front. This version entered production in June 1942, and was highly effective against anti-tank rifle fire since the bullet tended to deflect after passing through the first 20mm plate before striking the main armour. Nevertheless, side armour remained only 30mm. This uparmouring programme was extended to other German tanks such as the PzKpfw IV.

The main advantage of the anti-tank rifles was their number rather than their power. There were 8,116 on hand on 1 January 1942, though many of these had yet to be issued to front-line units. By July 1942, the number of anti-tank rifles had increased to 65,365 and by the beginning

For obscure reasons, the Tula small-arms plant began manufacturing a copy of the German PzB 39 in the late summer of 1941. These weapons were mainly used by workers' militias in the defence of Tula and one can be seen here in use in a strongpoint at the corner of Kommunar Street and Sovetskaya Street in the city in the autumn of 1941.



of 1943 to 118,563 rifles. The rifle regiments under the December 1941 tables had a nominal strength of 27 anti-tank rifles each, located in an anti-tank rifle company. Each company had three platoons, each with three squads that were armed with three anti-tank rifles per squad. This remained the standard configuration through most of the war. At divisional level, there was an anti-tank battalion which had an enlarged anti-tank rifle company armed with 36 rifles. There were additional anti-tank rifles scattered through the divisional organization, for example two in each field artillery battery for self-defence. Divisional anti-tank rifle strength reached its peak in the March 1942 table with 279 rifles per division, falling to 228 in July 1942, 212 in December 1942 and 107 in December 1944. The declines in 1942 were due to the shrinking manpower in each division, while the declines in 1944 were due to the growing obsolescence of the rifles in the face of thicker German tank armour. During the fighting on the approaches to Stalingrad in the summer and autumn of 1942, the Red Army began deploying special anti-tank battalions with 108 anti-tank rifles each.

There is very little statistical data regarding the actual number of tank kills credited to Soviet anti-tank rifles. The number of tanks actually destroyed was probably low, but the number of tanks damaged as well as crewmen killed or wounded was more significant. On 18 February 1942, the head of the German general staff, Generaloberst Franz Halder, complained to armaments minister Albert Speer that the new Soviet rifles were far more effective than the German 7.92mm PzB 39 rifle and he demanded that Speer take action. The growing number of anti-tank rifles on the battlefield created a ubiquitous threat, even if the German tanks were largely invulnerable from the front due to new appliqué armour.

The anti-tank rifle problem did not go away. At the 17 February 1943 Führer conference, members of the Panzerkommission proposed to Hitler that a *Schutzpanzer* (armour shield) be added to the sides of German tanks. Hitler was given a demonstration in late March 1943,

#### OPPOSITE

No doubt a staged photo, nevertheless this is an excellent illustration of a Soviet PTRD crew in action with the assistant gunner ready to hand the gunner another round of 14.5mm ammunition from the standard 20-round 14.5mm cartridge pouch. This photo was taken on the Southwestern Front in 1942.







The Red Army's anti-tank rifles became less effective in 1942 with the increase in German tank armour. This led to mixed anti-tank defences, with the anti-tank rifles supplemented by troops armed with shaped-charge anti-tank grenades. Here, the rifleman in the foreground has a VPGS-41 anti-tank rifle grenade loaded on his rifle, while in the background is a 14.5mm PTRS anti-tank rifle crew.

The side aprons (*Schürzen*) were added to new-production PzKpfw III and PzKpfw IV tanks as well as to StuG III assault guns by May 1943 in time for the summer offensive around Kursk. The Tiger I heavy tank did not need such protection due to its thick side armour that was already proof against anti-tank rifles. Panther tanks received a partial set of side plates over their running gear since the side turret and superstructure armour was already adequate.

The advent of armoured side aprons prior to the Kursk offensive seriously diminished the combat effectiveness of the Soviet anti-tank rifles in the summer 1943 fighting. For example, Guards Colonel Teremov of the 108th Rifle Division wrote an assessment after the fighting on the northern Orël Front in which he concluded 'Combat experience shows that keeping an anti-tank rifle company as a permanent part of the rifle regiment is no longer sensible'. He pointed to his own division's experience in combat against 20. Panzer-Division in the fighting for Stolbcheye village in the Bolkov sector during 19–23 July 1943. Even with more than 200 anti-tank rifles, his division only managed to knock out two light tanks and two armoured cars while at the same time losing 45 anti-tank rifles and their crews; divisional casualties were 3,500 men. In six months of fighting from June 1943 to January 1944, the divisional anti-tank rifles destroyed only two light tanks, two armoured cars, three automobiles and 12 machine-gun nests.

The diminishing effectiveness of the anti-tank rifles was reflected in the experiences of German Panzer crews as well. A StuG III gunner, Armin Sohns, described his encounters with Soviet anti-tank rifles during the fighting south of Kremenchug on the Dnepr River in October 1943. His assault gun was fitted with the side aprons.

Our vehicle received no less than ten hits by anti-tank rifles on the left side apron. Seven of these, hitting at an angle, glanced off, leaving dents just short of penetrations. Three were clean penetrations, but not enough punch left to do damage to the vehicle. We were unaware of

and ordered their production. These proved effective against captured Soviet anti-tank rifles, even at a minimal range of 100m. Aside from slowing the bullet as it passed through the screen, the impact often made the bullet unstable which degraded its penetration when it finally came into contact with the main armour of the tank.



About 3,200 Boys Anti-Tank Rifles were shipped to the Soviet Union, a large proportion of which were associated with the 2,360 Universal Carriers that had been sent. As a result, the Boys rifle was most commonly used in the Red Army as vehicle armament rather than in infantry units.

these hits until we examined our StuG after the action. The problem was these anti-tank rifles offered a very small target not much bigger than an ordinary rifleman, and were almost impossible to detect. (Sohns 1968)

A comparison of the PTRD and PTRS anti-tank rifles by the 51st Army in September 1944 strongly favoured the PTRD due to its greater reliability. Interviews with Red Army anti-tank rifle gunners included the following comments:

The Simonov rifle starts jamming after only a small amount of fouling in the chamber, after 10–15 shots. Degtyarëv's rifle is flawless in its action ... The rate of fire is the only good quality of the PTRS. There are no positive reviews of its reliability, only negative. After 10–15 shots, it starts jamming, and these jams are hard to fix, consume a lot of time, which is unacceptable in modern fast-paced battle ... Anti-tank rifle units prefer to be armed with PTRD rifles, as they are lighter and more reliable ... The Degtyarëv anti-tank rifle has an insufficient

### **Red Army PTRS anti-tank rifle team, Kursk, 1943 (overleaf)**

By the summer of 1943, the recognized shortcomings of the PTRS and PTRD anti-tank rifles led the Red Army to deploy them as part of a mixed anti-tank defence belt. They were also integrated into other anti-tank defences, especially minefields and anti-tank ditches. The anti-tank rifles could cover the minefields from German *Pionier* troops trying to breach the fields and trenches. At the same time, they could intercept and destroy any German tanks moving through the anti-tank defences. By the time of the battle of Kursk in July 1943, the PTRS and PTRD had become increasingly marginal in the anti-tank battle. The German Army introduced *Schürzen* (armour aprons) on the sides of its medium tanks and assault guns, which made the anti-tank rifles nearly worthless except for a lucky shot.









SHUMATE  
2011

rate of fire for fighting tanks, reloading takes too long. The rate of fire of Simonov's rifle is good, but it is too heavy when attacking ... The rate of fire of the PTRS is 10–15 RPM, of the PTRD is 8–10 RPM ... Currently, anti-tank rifles are rarely used against tanks, as our units are stuffed with anti-tank guns. The anti-tank rifles are normally used to destroy vehicles, prime movers, and light armored cars.

Soviet anti-tank rifles remained in widespread use until the end of World War II. The June 1945 rifle division tables still included 111 rifles, due largely due to the failure of Soviet industry to develop a satisfactory shaped-charge anti-tank launcher comparable to the American 2.36in bazooka, British PIAT or German *Panzerfaust* and *Panzerschreck*. Soviet industry did produce anti-tank rifle grenades and shaped-charge artillery rounds, but rocket-propelled grenades were not perfected until after the war. Even though the anti-tank rifle had little effectiveness against armoured vehicles in the later years of the war, it was still regarded as a worthwhile weapon since it could be used against a wide range of other non-armoured targets.

## **JAPANESE ANTI-TANK RIFLES IN COMBAT**

By the time it entered service, the Type 97 automatic anti-tank gun was regarded as much as a general support weapon as a dedicated anti-tank weapon. In the infantry battalion, 24 of these weapons were deployed in the Battalion Gun Company with four anti-tank rifle platoons, each with two 20mm cannon and tactically distributed on a scale of one anti-tank platoon per infantry company. Each anti-tank rifle section consisted of ten men and a single 20mm Type 97 anti-tank cannon. The section included an NCO/section leader, four gun crewmen to carry the Type 97, four bearers each carrying an ammunition box with six magazines, and two horse-handlers. The section was nominally assigned nine horses, six of them carrying ammunition and three carrying the Type 97 gun in dismantled condition.

The 20mm Type 97 cannon made its combat debut against Soviet forces in the various border battles against the Red Army in Manchuria during 1939. Soviet tanks of this period were lightly armoured and vulnerable to this weapon at close ranges. Soviet records from the battle for Nomonhan (Khalkhin-Gol) indicate that a number of AFVs were disabled by Type 97 fire.

By the time the Type 97 saw extensive deployment in China in 1940–41, it faced few Chinese tanks. Ammunition production switched away from armour-piercing ammunition; the majority of rounds manufactured in 1941–42 were the high-explosive type. The Imperial Japanese Army significantly reorganized its units for deployment in the island campaigns in the Southwest Pacific in 1941–44, where these weapons were not widely used. They were largely ineffective against US tanks after 1942. Besides Army use, the 20mm Type 97 cannon was also deployed with the air forces' Teishin Shudan airborne raiding forces.

## Anti-tank rifles in Asia and the Pacific in 1941–45

The Boys Anti-Tank Rifle was provided to British and Commonwealth forces in the Malaya–Singapore area prior to the outbreak of war in 1941. The typical Japanese tanks of this period such as the Type 95 Ha-Gō light tank were vulnerable to this weapon, though the Boys does not appear to have had much impact on the fighting in 1941–42. There have been reports that some Boys anti-tank rifles destined for Malaya ended up with American forces in the Philippines in 1941–42, but there is little if any evidence that this occurred. The army of the Dutch East Indies (KNIL) did receive modest numbers of the Solothurn S 18-1000 anti-tank rifle prior to the Japanese landings, but information on their combat use is lacking.

Boys anti-tank rifles were provided to Australian forces and accounted for the first Japanese tank disabled and captured by Australian forces during the New Guinea campaign, namely a Type 95 Ha-Gō that had landed at Milne Bay at Ahioma on 25 August 1942. Owing to the nature of the fighting in mountainous and tropical New Guinea as well as the absence of large numbers of Japanese tanks, the Boys Anti-Tank Rifle soon became very unpopular with Australian troops due to its weight.

The US Marine Raider battalions, formed in 1942, had a distribution of 14 Boys anti-tank rifles per battalion. These were the only American units known to operate the Boys in combat. They were distributed on a scale of four in the Raider HQ company, two in each of the four Raider rifle companies and two in the demolition platoon of the weapons' company. The first and most famous use of the Boys by the Marines was the raid on Makin atoll on 17–18 August 1942 by Lieutenant Colonel Evans Carlson's 2nd Raider Battalion. Two Japanese seaplanes floating in the Makin lagoon were attacked with anti-tank rifle fire. One seaplane

burst into flames and the second attempted to escape but was so damaged by anti-tank rifle fire that it crashed. The Marine Raiders used the Boys in other campaigns including the fighting on New Georgia in the summer of 1943 by the 1st Raider Battalion. Opinions about the gun were mixed. One report said that the Raiders loved the 'hard-hitting elephant gun', while an after-action report from New Georgia reported that the 'Rifle, Boys, AT, Cal. 55: of absolutely no use in jungle warfare'.

China was provided with 6,129 Canadian-manufactured Boys Mk I\* anti-tank rifles under the Lend-Lease programme in 1942–44. The standard allotment in 1942 was 36 rifles per division. The Boys did not see widespread distribution with Chinese forces until the summer of 1943, and it was not in widespread demand due to the relative rarity of encounters with Japanese tanks. It could be used to good effect, however, for example in April 1945 when a special anti-tank company of the 85th Army set up a road ambush in Zhong Yangdian in western Henan province, knocking out two Japanese light tanks and forcing a Japanese column to retreat. Chinese forces were not very keen on the Boys, however, due to its weight and its mediocre performance against Japanese bunkers. In April 1945, the Supreme HQ Chinese Armies requested the retirement of the Boys from deployment in favour of the more versatile bazooka. As a result, only about one-third of the Boys anti-tank rifles shipped to this theatre of operations were deployed with Chinese troops, and most never left their depots in India.

The Boys Anti-Tank Rifle Mk I\* saw limited use by US Marine Corps Raider units in the Southwest Pacific. Here, a Raider patrol is shown near Enogai Point on New Georgia in August 1943, with one of the Marines carrying an 'Elephant Gun'.







# IMPACT

## An ineffectual weapon

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In general, anti-tank rifles were one of the least successful and most detested forms of infantry small arm. They were large, heavy, and awkward to use. More importantly, with rare exceptions, they had very little chance of success on the battlefield.

The armour on tanks from their earliest days was predicated on their ability to resist small-arms fire, from both infantry rifles and machine guns. Anti-tank rifles were more powerful than the rifles and machine guns of their day, but not powerful enough to inflict sufficient damage on enemy tanks. The engineering challenge was essentially impossible when using conventional bullets since it required a weapon that was light enough to be carried and employed by the infantry while at the same time having sufficient energy to penetrate tank armour. While many anti-tank rifles were capable of penetrating armour, in the process their bullets lost so much of their energy that by the time they entered the interior of the tank, they had insufficient energy to cause any crippling damage to the tank itself. As described earlier in this book, the German T-Gewehr of 1918 and the Polish wz.35 were both capable of penetrating the tanks of their day, but neither rifle could cause enough damage to destroy a tank. At best, they could injure some or all of the crewmen or temporarily stop a tank by causing mechanical damage.

One solution was to shift to a larger bullet that could incorporate a high-explosive charge to cause damage once penetration occurred. This was the reason for the interest in very heavy anti-tank rifles such as the 20mm Solothurn, because the bullet used was large enough to contain both a high-explosive charge as well as a fuze to detonate the charge. This came at the expense of creating an especially heavy and unwieldy weapon that was only marginally portable.

In the wake of the Spanish Civil War, tank armour began switching from 'bullet-proof' armour in the 15–20mm range to 'shell-proof' armour,





A German Panzerfunkwagen 6-rad SdKfz 263 knocked out during the September 1939 campaign in Poland, apparently from an anti-tank rifle strike into the front engine compartment. Although well-angled, the armour on this armoured car was only 8mm thick, leaving it vulnerable to Polish anti-tank rifle fire.

40mm or thicker. With the arrival of shell-proof armour, anti-tank rifles became useless in frontal engagements with tanks, though they sometimes had marginal utility when engaging the thinner side armour. The new shell-proof armour was designed to resist the impact of typical anti-tank guns of the Blitzkrieg era, notably the German 3.7cm PaK 36 anti-tank gun. This weapon had a muzzle energy of about 190,000J. In comparison, the most powerful 20mm anti-tank rifles had muzzle energies of only 50,000J, about one quarter the energy of the anti-tank guns. It was impossible to create a man-portable anti-tank rifle capable of delivering as much kinetic energy as a 37mm gun.



French tanks had been designed with 40mm frontal armour to resist 37mm anti-tank fire. Nevertheless, this could be penetrated by 37mm armour-piercing rounds at close range, as shown on this Hotchkiss H 39 of the 11e Régiment de Dragons Portés knocked out during the fighting against 4. Panzer-Division on 13 May 1940 near Hannut in Belgium. The smaller strikes on the armour are probably from machine guns and anti-tank rifles.

| Anti-tank rifles: comparative technical characteristics |         |        |               |                          |         |                 |
|---------------------------------------------------------|---------|--------|---------------|--------------------------|---------|-----------------|
| Weapon                                                  | Calibre | Length | Barrel length | Barrel length (calibres) | Weight  | Muzzle velocity |
| T-Gewehr                                                | 13mm    | 1.70m  | 870mm         | L/67                     | 18.5kg  | 780m/sec        |
| KbP wz.35                                               | 7.92mm  | 1.76m  | 1,200mm       | L/151                    | 9.1kg   | 1,280m/sec      |
| PzB 39                                                  | 7.92mm  | 1.58m  | 1,085mm       | L/137                    | 12.6kg  | 1,140m/sec      |
| Boys                                                    | 13.9mm  | 1.62m  | 915mm         | L/65                     | 16.3kg  | 990m/sec        |
| PTRS                                                    | 14.5mm  | 2.10m  | 1,350mm       | L/93                     | 20.9kg  | 1,012m/sec      |
| PTRD                                                    | 14.5mm  | 2.02m  | 1,350mm       | L/93                     | 17.3kg  | 1,012m/sec      |
| S 18-100                                                | 20mm    | 1.76m  | 930mm         | L/46.5                   | 45kg    | 750m/sec        |
| S 18-1000                                               | 20mm    | 2.16m  | 1,300mm       | L/65                     | 54.7kg  | 910m/sec        |
| Lahti L-39                                              | 20mm    | 2.23m  | 1,393mm       | L/69.5                   | 51kg    | 840m/sec        |
| Type 97                                                 | 20mm    | 2.09m  | 1,065mm       | L/53                     | 52–68kg | 805m/sec        |

| Anti-tank rifle cartridges: comparative technical data |                 |                  |                |                |                   |                   |
|--------------------------------------------------------|-----------------|------------------|----------------|----------------|-------------------|-------------------|
| Cartridge                                              | Designation     | Core             | Overall length | Overall weight | Projectile weight | Propellant weight |
| 13.2×92mmSR                                            | TuF             | steel            | 133.2mm        | 63g            | 51.5g             | 18g               |
| 7.92×107mm                                             | DS              | lead             | 131.2mm        | 64.2g          | 14.6g             | 11.2g             |
| 7.92×94mm                                              | Patrone 318     | tungsten carbide | 118mm          | 85.5g          | 14.8g             | 14.9g             |
| 13.9×99mmB                                             | W Mk I          | steel            | 133.3mm        | 150g           | 60.2g             | 12g               |
| 13.9×99mmB                                             | W Mk II         | steel            | 128mm          | 139g           | 47.6g             | 13.7g             |
| 14.5×114mm                                             | BS-41           | tungsten carbide | 155.8mm        | 200g           | 64.4g             | 30.6g             |
| 14.5×114mm                                             | B-32            | steel            | 155.4mm        | 200g           | 64.2g             | 30.5g             |
| 20×105mmB                                              | Short Solothurn | steel            | 170mm          | 290g           | 140g              | 29g               |
| 20×138mmB                                              | Long Solothurn  | steel            | 203mm          | 337g           | 147g              | 39g               |
| 20×125mm                                               | Type 100        | steel            | 193.6mm        | 322g           | 156g              | 35.8g             |

| Anti-tank rifle armour penetration: comparative technical data |             |                 |        |                 |             |          |         |          |
|----------------------------------------------------------------|-------------|-----------------|--------|-----------------|-------------|----------|---------|----------|
| Rifle                                                          | Cartridge   | Designation     | Energy | Muzzle velocity | Penetration |          |         |          |
|                                                                |             |                 |        |                 | 100m@0°     | 100m@30° | 300m@0° | 300m@30° |
| T-Gewehr                                                       | 13.2×92mmSR | TuF             | 15.4kJ | 780m/sec        | 20mm        | 14mm     | 15mm    | 10mm     |
| KbP wz.35                                                      | 7.92×107mm  | DS              | 9.5kJ  | 1,280m/sec      | 33mm        | 15mm     | 16mm    | 13mm     |
| PzB 39                                                         | 7.92×94mm   | Patrone 318     | 10.5kJ | 1,160m/sec      | 30mm        | 23mm     | 23mm    | 10mm     |
| Boys                                                           | 13.9×99mmB  | W Mk I          | 16.8kJ | 750m/sec        | 17mm        | 14mm     | 14mm    | 11mm     |
| Boys                                                           | 13.9×99mmB  | W Mk II         | 18.6kJ | 885m/sec        | 23mm        | 16mm     | 21mm    | 15mm     |
| PTRS/PTRD                                                      | 14.5×114mm  | BS-41           | 32kJ   | 1,012m/sec      | 50mm        | 35mm     | 40mm    | 33mm     |
| PTRS/PTRD                                                      | 14.5×114mm  | B-32            | 32kJ   | 1,012m/sec      | 40mm        | 30mm     | 35mm    | 27mm     |
| S 18-100                                                       | 20×105mmB   | Short Solothurn | 37kJ   | 750m/sec        | 35mm        | 20mm     | 27mm    | 15mm     |
| S 18-1000                                                      | 20×138mmB   | Long Solothurn  | 47kJ   | 910m/sec        | 40mm        | 27mm     | 35mm    | 24mm     |
| Lahti L-39                                                     | 20×138mmB   | Long Solothurn  | 47kJ   | 840m/sec        | 37mm        | 26mm     | 33mm    | 20mm     |
| Type 97                                                        | 20×125mm    | Type 100        | 50kJ   | 805m/sec        | 35mm        | 24mm     | 30mm    | 20mm     |



By 1941, anti-tank rifles had only marginal value on the battlefield and this photo helps demonstrate why. The round on the left is a German 3.7cm PaK 36 anti-tank projectile, derisively called the 'door-knocker' after the first encounters with Soviet T-34 and KV tanks in 1941. The heaviest of the anti-tank rifle rounds, the 20mm 'Long Solothurn' in the centre, was puny in comparison and had correspondingly lower armour penetration. On the right is a Boys .55in round, even more irrelevant for tank fighting.

There were some attempts to bridge the gap between 20mm anti-tank rifles and 37mm anti-tank guns. The Swiss Army, for example, adopted a 24mm anti-tank rifle, and the Wehrmacht developed a 20/28mm tapered-bore gun. These weapons were so heavy that they were permanently affixed to a carriage, however. They were not rifles in any meaningful sense, but rather small anti-tank guns. Even though they were lighter than typical 37mm anti-tank guns, they still required motor transport for travelling any distance. At the same time, they had anti-armour penetration inferior to that of 37mm anti-tank guns.

To seal the fate of the anti-tank rifle further, tank armour began to rapidly escalate after 1941. The designers of the Soviet T-34 tank, not satisfied just to protect their new design against 37mm anti-tank guns, realized that by the time the T-34 entered combat, a new generation of anti-tank guns would be on the drawing boards. So they designed the T-34 to resist a much greater threat than the 37mm anti-tank gun. The T-34 had 45mm armour angled at 60 degrees which gave it an effective thickness of 90mm to frontal attack. In 1940 the German Army had begun production of the new 5cm PaK 38 anti-tank gun, which had a muzzle energy of about 720,000J, about four times as much as the 37mm anti-tank gun and about 15 times more powerful than the most powerful anti-tank rifle. Even the 5cm PaK 38 was not effective against the frontal armour of the T-34, however. This forced the German Army to adopt the 7.5cm PaK 40 in 1942, by which time most major armies were adopting heavier and heavier tank armour, making the task of anti-tank rifles increasingly difficult.

Perhaps the most curious chapter in the history of anti-tank rifles was the long-delayed Soviet decision in the summer of 1941 to begin a crash programme to field such weapons. Not only was the Red Army the last major army to adopt anti-tank rifles, but they manufactured them on an unprecedented scale. The Red Army had developed anti-tank rifles before the start of World War II, but for a variety of reasons described previously, had halted production before the start of Operation *Barbarossa* on 22 June 1941. The crushing defeats in the summer of 1941 were largely attributed to the success of the German Panzer divisions. One aspect of these defeats was widespread ‘tank-panic’ in the ranks of the Red Army infantry since they lacked any means at small-unit level to combat enemy tanks. The decision to begin anti-tank rifle production at such a late date was partly due to tactical necessity but also to the recognition that infantry units were more apt to hold their ground during a tank attack if they had any hope that they could defend themselves against the enemy tanks. It is worth noting that the massive Soviet anti-tank rifle programme was only one aspect of a major effort to deploy infantry anti-tank weapons that also included many stop-gap weapons such as rifle grenades, anti-tank mines and factory-produced Molotov cocktails. A contributory factor in the Soviet anti-tank rifle programme was the very slow pace of armour upgrades on German tanks in 1939–41 compared to most other European armies.



| Comparative production of anti-tank rifles                         |         |          |
|--------------------------------------------------------------------|---------|----------|
| Type                                                               | Years   | Quantity |
| PTRD                                                               | 1941–44 | 281,111  |
| PTRS                                                               | 1941–45 | 190,615  |
| Boys*                                                              | 1937–43 | 114,081  |
| PzB 39                                                             | 1940–41 | 39,232   |
| T-Gewehr                                                           | 1918    | 15,800   |
| KbP wz.35                                                          | 1937–39 | ~6,000   |
| Solothurn S 18**                                                   | 1934–43 | 5,000?   |
| PzB M SS 41                                                        | 1941–43 | ~3,000   |
| Lahti L-39                                                         | 1940–44 | 2,076    |
| PzB 38                                                             | 1940–41 | 1,408    |
| Type 97                                                            | 1939–43 | 1,108    |
| * includes Canadian production    ** includes Hungarian production |         |          |

Anti-tank rifles were declared obsolete by most armies in 1942–43 due to the changes in tank armour. A second factor in the demise of the weapons was the advent of practical shaped-charge anti-armour warheads. The idea of a shaped-charge device had been known in engineering circles since the late 19th century. The application of shaped charges for military purposes was more recent, however. Hand-emplaced shaped-charge devices were used in the German air-landed attack on the Belgian fortresses in 1940 to penetrate armoured cupolas.

Shaped charges relied on the use of high explosives shaped around a hollow metal cone, hence they were also called ‘hollow charges’. Upon detonation, the shaped charge deformed the metal cone into a hypersonic metallic stream that could penetrate very thick steel armour. In 1939–40, the Swiss engineer Henri Mohaupt began marketing an anti-tank rifle grenade using the shaped-charge principle. His concept was picked up by the French Brandt armaments firm, and was demonstrated to both the British and US armies. This concept began to disseminate widely in 1940. By 1941, many armies had begun to adopt anti-armour rifle grenades. A typical anti-tank rifle grenade of this period, the US Army’s M9A1, had a 4oz (113g) high-explosive charge and could penetrate about 50mm of armour, which was as much as the most powerful anti-tank rifle. Not only could a shaped charge penetrate tank armour, but after the penetration occurred, a stream of molten metal was sprayed into the interior of the tank, causing significant over-pressure inside the tank, and potentially igniting fires. As a result, the ‘behind-armour effect’ of the shaped charge was considerably more lethal than the bullet from any anti-tank rifle.

The main problems with rifle grenades were their inherent inaccuracy and the erratic performance of their fuzes. Rifle grenades were launched from a special adaptor fitted to the end of the rifle barrel and propelled by a special cartridge which imparted enough energy to make them fly about 100m. This launch method was not sufficiently powerful to fire them horizontally for any great distance, however, and it was difficult to obtain pinpoint accuracy when launching them on a curved ballistic

trajectory. Furthermore, even when they did hit an enemy tank, often they bounced off when their primitive fuzes failed to detonate the shaped charge at precisely the right moment. They were used in very large numbers in 1941–43 as a stop-gap method to give infantry some modest anti-tank self-defence capability.

The breakthrough came when the rifle grenades were combined with new rocket technology, creating the modern-day rocket-propelled grenade. The main advantage of rocket propulsion was that the grenade could be fired in a flat, horizontal trajectory, making it much easier for an infantryman to hit a small target such as a tank at 100–300m. The first example was the US Army's 2.36in 'bazooka' rocket launcher that saw its combat debut in November 1942 in the Operation *Torch* landings in North Africa. Germany captured some bazookas in Tunisia in February 1943 and used the technology to develop the enlarged 8.8cm *Panzerschreck* copy. This later led to a smaller disposable type, the *Panzerfaust*. Britain was an outlier in this technology, fielding the PIAT that launched a shaped-charge grenade by means of a powerful spring instead of a rocket.

Improvements to the shaped-charge warhead allowed it to keep pace with increasing tank armour thicknesses. The size of the warhead could be increased, and there were also other important innovations in the design of the metal liner and the fuzing. Indeed, rocket-propelled grenades have become the primary infantry anti-tank weapon to this day due to their steady evolutionary development.

The other major advantage of the rocket-propelled grenade over the anti-tank rifle was the matter of weight and portability. A bazooka weighed only 7kg so it could be easily carried by a single rifleman. It is interesting to note that the US Army was still considering a .60-cal. anti-tank rifle in late 1942; and the Infantry Board report that cancelled this anti-tank rifle specifically mentioned the weight advantages of the bazooka over an anti-tank rifle:

It will require a five-man crew in order to break the .60 caliber AT rifle down into one-man loads. This team can carry 160 rounds of ammunition. The total weight carried will be approximately 233 pounds [106kg]. The two-man M1 Rocket Launcher can carry one launcher and eleven rounds of ammunition. The total weight will be approximately 71 pounds [32kg]. One rifle grenadier can carry his rifle with launcher and 22 AT grenades. The total weight will be approximately 40 pounds [18kg]. The .60 caliber AT rifle is a single purpose weapon whereas the 2.3 inch rocket launcher and rifle grenade launcher can be used for both personnel and AT grenades.

The arrival of the first rocket-propelled grenades and comparable weapons such as the PIAT in late 1942 and early 1943 occurred at roughly the same time that anti-tank rifles had become obsolete due to the increases in tank armour.

Curiously enough, anti-tank rifles did not disappear immediately. Their decline was not a sudden development, but rather the result of a



gradual diminution in their effectiveness. Armies were quick to appreciate that anti-tank rifles could be used against targets other than tanks. For example, the Boys Anti-Tank Rifle was still in large-scale service with British and Commonwealth forces in the desert campaigns in 1941–42 even though it had little hope of stopping a German tank. The British Army continued to point to the merits of the Boys rifle in combating enemy armoured cars, but there were not enough enemy armoured cars to justify keeping such a heavy and unwieldy weapon in large-scale front-line service. Even so, the Boys rifle was perfectly useful for shooting at many other targets. Anti-tank rifles could penetrate most brick and concrete structures, short of steel-reinforced concrete bunkers. They could still be used for long-range engagements of German and Italian infantry strongpoints protected by rocks or sandbags that were impervious to ordinary rifle fire. It can certainly be argued that the anti-tank rifle was the forerunner of the modern anti-matériel rifle, even though this term was not in use in 1943–45.

The infantry tolerated the heavy weight of anti-tank rifles so long as the rifles were still effective. This Finnish L-39 in use near Vyborg on 25 August 1941 was credited with two Soviet tanks, both of which were subsequently recovered and put back into use due to the light damage inflicted on them. (SA-kuva)



## CONCLUSION

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The anti-tank rifle largely disappeared from the battlefield in Western Europe by 1943 with the arrival of the bazooka, PIAT and *Panzerschreck*. Anti-tank rifles remained in widespread service on the Eastern Front through to the end of World War II, however. This was due to the lack of a suitable replacement as well as their utility as a general-purpose support weapon. The Red Army was the only major army not to adopt a rocket-propelled grenade launcher in World War II. They had been supplied with American 2.36in bazookas in 1942, yet seem to have made no effort to copy them. Indigenous designs were developed in 1943–45, but none was accepted for series production during the war. The reasons for this curious failure have never been fully explained, although Russian accounts do indicate that there were problems with the manufacture of rocket fuel and reliable impact fuzes. As a result, the Red Army kept the anti-tank rifle in widespread service through to the end of the war in spite of its growing irrelevance in tank fighting.

A PzB 39 in service in the Soviet Union during Operation *Barbarossa* in the late summer of 1941. Although the PzB 39 was still effective against Soviet light tanks in 1941, its service career would prove to be short because of the dramatic increase in Soviet tank armour.







The retention of anti-tank rifles by the Red Army was not entirely unique, except in terms of scale. Finland continued to manufacture its 20mm Lahti L-39 anti-tank rifle until the summer of 1944, though the last batch was actually intended for use as a light anti-aircraft gun. Anti-tank rifles remained viable in some theatres, such as China, where tanks were few in number and thinly armoured.

Anti-tank rifles remained on the battlefield in diminishing numbers into the 1950s, largely due to Soviet influence. They were provided as part of an arms package to the North Korean Army in 1949–50 and so saw use in the Korean War of 1950–53. They largely disappeared after this with the belated arrival of the Soviet RPG-2 rocket-propelled anti-tank grenade launcher. By the 1950s, anti-tank rifles were historical curiosities rather than significant battlefield weapons. They have appeared in small numbers since then. For example, a few old PTRD anti-tank rifles appeared during the fighting in Ukraine in 2015.

One of the last refuges of the anti-tank rifle is among small-arms collectors in the United States. Owing to lenient gun laws, Americans were able to purchase anti-tank rifles in the 1950s and 1960s. Finland declared its diverse arsenal of anti-tank rifles surplus in the 1950s. Gun dealers in the United States recognized that they might have some appeal to American collectors and so there was a sudden influx of hundreds of anti-tank rifles of different types from Finland including the Boys, PzB 39 and Lahti L-39. These appear on gun ranges with some regularity, though many Boys rifles have been rechambered for the readily available .50-cal. Browning machine gun (BMG) cartridge.

A side-by-side comparison of the Degtyarëv PTRD in the foreground and the Simonov PTRS in the background at the Central Armed Forces Museum in Moscow.

## FURTHER READING

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Aside from the old Hoffschmidt book, there are few overviews of anti-tank rifles. The Fedoseyev book *Pekhota protiv tankov: protivotankovye sredstva blizhnego boya v 1939–45* (Infantry against Tanks: Anti-tank Devices for Close-Combat 1939–45) offers an excellent overview of infantry anti-tank weapons in World War II, but will not appeal to most readers since it is in Russian. There are several national surveys of small-arms development that contain useful details about local anti-tank rifle development. The German weapons magazine *Waffen Revue* has many detailed articles on various anti-tank rifles, but once again, the language issue is a barrier as well as problems with the availability of back issues of this magazine outside Germany.

Anti-tank rifles come up for auction in the United States on a regular basis and some of the prominent auction houses such as Rock Island Auctions and James Julia have interesting websites with excellent photographic coverage of their offerings. The website Forgotten Weapons ([www.forgottenweapons.com](http://www.forgottenweapons.com)) features both articles and excellent YouTube videos about these weapons. The Archives Awareness website ([tankarchives.blogspot.com](http://tankarchives.blogspot.com)) has many interesting Red Army documents regarding Soviet anti-tank rifles.

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Front cover, above: A Boys Anti-Tank Rifle. (MKFI)  
Front cover, below: The 20mm L-39 anti-tank rifle was one of the most substantial wartime infantry weapons, as is evident here with this Finnish anti-tank rifle team near Latva on 7 June 1942. (SA-kuva)  
Title page: A Soviet PTRS crew in action in Ukraine in 1942. The standard 20-round cartridge pouch can be seen on the gunner's hip.

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## Editor's note

Metric measurements are used in this book. For ease of comparison please refer to the following conversion table:

1m = 1.09yd / 3.28ft / 39.37in  
1cm = 0.39in  
1mm = 0.04in  
1kg = 2.20lb  
1g = 0.04oz

## Glossary

|                  |                                                                                                              |
|------------------|--------------------------------------------------------------------------------------------------------------|
| <b>AT</b>        | anti-tank                                                                                                    |
| <b>B</b>         | belted case                                                                                                  |
| <b>GAU</b>       | Glavnoe artilleriyskoye upravlenie: Main Artillery Directorate (Russian)                                     |
| <b>GPK</b>       | Gewehrprüfungskommission: Gun Testing Commission (German)                                                    |
| <b>GrB 39</b>    | Granatbüchse Modell 39: grenade rifle 1939 (German)                                                          |
| <b>HWA</b>       | Heereswaffenamt: Army Ordnance Department (German)                                                           |
| <b>it kiv</b>    | <i>ilmatorjunta-kivääri</i> : anti-aircraft rifle (Finnish)                                                  |
| <b>Kb.Ppanc.</b> | <i>Karabin przeciwpancerny</i> : anti-tank rifle (Polish)                                                    |
| <b>KNIL</b>      | Koninklijk Nederlands-Indisch Leger: Royal Dutch East Indies Army (Dutch)                                    |
| <b>NIPSVO</b>    | Nauchno-ispatyvatel'nyy polygon strekovogo vooruzhenie: Small Arms Research-Testing Proving Ground (Russian) |
| <b>PFK</b>       | Panstwowa Fabryka Karabinów: State Rifle Factory (Polish)                                                    |
| <b>PIAT</b>      | Projector Infantry Anti-Tank                                                                                 |
| <b>pst kiv</b>   | <i>panssarintorjunta-kivääri</i> : anti-tank rifle (Finnish)                                                 |
| <b>PTRD</b>      | Protivotankoviy ruzhë Degtyarëva: Degtyarëv Anti-Tank Rifle (Russian)                                        |
| <b>PTRS</b>      | Protivotankoviy ruzhë Simonova: Simonov Anti-Tank Rifle (Russian)                                            |
| <b>PzB</b>       | <i>Panzerbüchse</i> : anti-tank rifle (German)                                                               |
| <b>SmK</b>       | <i>Spitzgeschoss mit Kern</i> : pointed bullet with core (German)                                            |
| <b>SR</b>        | semi-rimmed case                                                                                             |
| <b>T-Gewehr</b>  | <i>Tankgewehr</i> : tank rifle (German)                                                                      |
| <b>TuF</b>       | <i>Tank und Flieger</i> : Tank and Aircraft (German)                                                         |
| <b>VKT</b>       | Valtion Kivääritehdas: State Rifle Factory (Finnish)                                                         |
| <b>wz.</b>       | <i>wzór</i> : model (Polish)                                                                                 |